The STORY of DENTISTRY

M. D. K. BREMNER

Dental History

Last week in Baltimore 5,000 dentists from all corners of the U. S. came together like so many well-fitting bicuspids, to celebrate a century of scientific dentistry. The dentists had good cause to show their teeth in pride, for as an art, U. S. dentistry is the world's finest. From the days when Dentist Isaac Greenwood supplied grim-lipped George Washington with a set of wooden teeth (they splintered), a set of iron teeth (port wine rusted them), and a dressy set of bone teeth, U. S. dentists have come far.

Keystone

"The Dentist" by Boilly (1820's)
"Be pitiless," counseled Dr. Harris.

For all their slick technique of drilling and filling, dentists have little more knowledge of the causes of tooth decay than they had 100 years ago. Dental caries (tooth decay) is the most prevalent disease in the U. S., attacks more than 95% of the population.

But the dentists at Baltimore reminded themselves how much worse things used to be:

▶ In 1840, high-minded Dentists Chapin Aaron Harris and Horace Henry Hayden opened the Baltimore College of Dental Surgery, first in the world. In the freshman class were five students, their only qualifications reading & writing, tough biceps. After a four-month course, the boys went out into the world to battle brawny patients, crazy with pain. "Be pitiless," counseled Dr. Harris. "As t' patient is very apt to catch the hand o the operator, he must have both hands ready and, when one is pulled away, seize the instrument with the other and so go on until the operation is complete."

Chief dental weapon at that time was "the key," a large iron hook with a head that ringed an aching tooth, a long handle for a good grip. "There never was a claw on bird or beast," wrote Dr. Oliver Wendell Holmes, "that was the cause of such anguish . . . such howls of agony as that diabolical instrument looking like a vulture's talon."

▶ Driven by necessity, dentists were pioneers in anesthesia. In 1844, Dentist Horace Wells of Hartford, Conn. inhaled laughing gas (nitrous oxide) before a colleague pulled his tooth. But the public jeered at his "remarkable discovery."

THE STORY OF DENTISTRY

The Story of Dentistry

FROM THE DAWN OF CIVILIZATION

TO THE PRESENT

By M. D. K. Bremner, D.D.S., F.A.C.D.

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DEDICATED TO THE

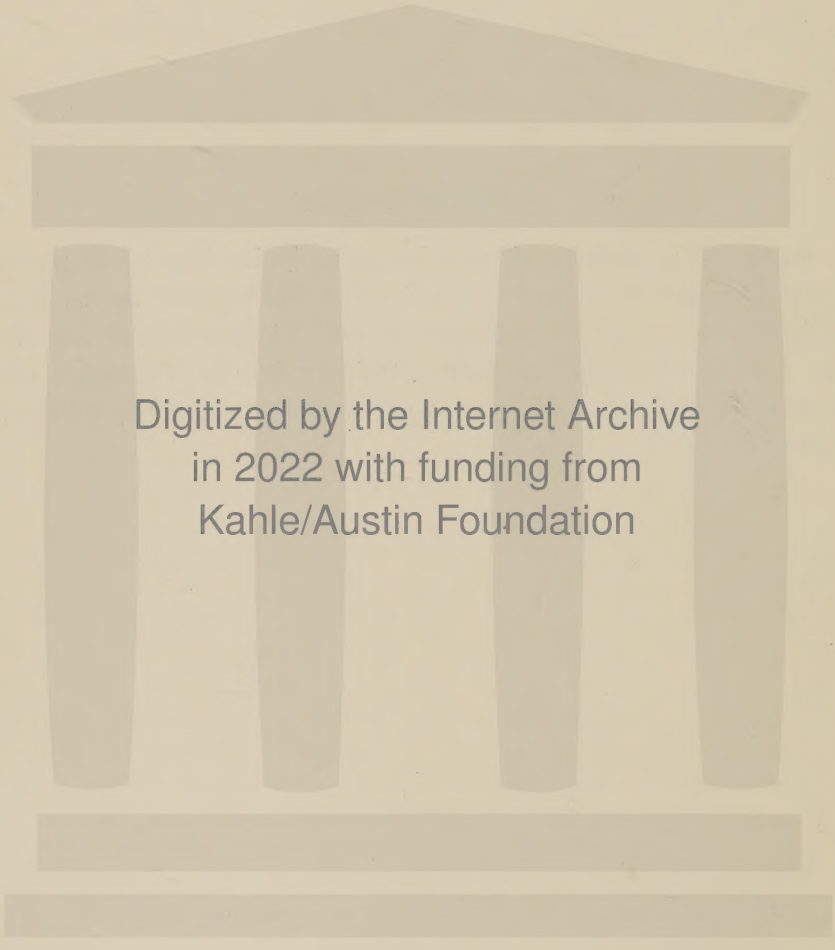
MEMORY OF

MY BROTHER

MITCHEL

AUTHOR'S NOTE

While this is intended primarily for the profession I have used popular rather than scientific terms and have included details which for the dental reader are quite obviously unnecessary, because I believe that many dentists may want to recommend the book to their lay friends. The simple non-technical style of the *Story of Dentistry* should interest every intelligent reader.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PREFACE

The story of dentistry as of every other phase in the cultural development of the race has its beginnings before the dawn of history. The savage who knocked out his aching molar with a stone chisel started the practice of exodontia. The medicine man who conjured an evil spirit to depart from a swollen jaw abscess was practicing dental therapeutics. And the young blade who ligated two animal teeth in place of the centrals he lost in a fight with a mastodon introduced restorative dentistry.

For thousands of years, progress was extremely slow. It was not until about 3500 or 4000 years B.C. in the Yangtze and Nile River Valleys that drugs and other remedies began to compete with magic and fetishes in the relief of dental ailments. Artificial restorations were unknown even among the highly gifted Egyptians. But about 2500 years ago, Athenian physicians were applying rational treatment to oral diseases, and the Etruscans in central Italy produced fairly satisfactory dental bridges and crowns. Later the Romans (with their magnificent talent for borrowing) combined Greek knowledge with Etruscan skill and raised dentistry to a fairly high level.

The fall of Rome ushered in the dark ages and but for the fragments of knowledge which the Arabians had saved, miracles and witchcraft again became the most widely used toothache remedies. The art of restoring missing teeth was almost forgotten. Then, after fifteen hundred years of darkness, there came a flicker of light; dentistry started to develop slowly.

The most notable of the several contributors during that period was Ambrose Pare, French surgeon and dentist. Early in the eighteenth century came Pierre Fauchard the "Father of Modern Dentistry." His famous book besides being an encyclopedia of dental information, established the precedent that whatever knowledge any dentist had should be shared freely with his fellows. That tradition was an ancient one in medicine. This new concept changed the practice of dentistry from a trade into a learned profession. Artificial teeth made of porcelain also originated in France, and was perhaps the last real contribution to restorative dentistry which Europe made for the next several decades.

PREFACE

Since about the middle of the nineteenth century, most progressive dental methods and appliances originated in the United States. The foundations were laid by Hayden and Harris when they organized the first special school for the training of dentists at Baltimore in 1840. That school, which was instrumental in separating dental from medical teaching, has often been considered the greatest single factor in the growth and progress of dentistry on the North American continent. Of course, the lucky accident that such men as Goodyear, Wells, Arthur and a number of others happened to be Americans was undoubtedly a significant contributing factor.

In the last three or four decades the development of dentistry has been phenomenal, largely because of the efforts of schools, dental societies, and numerous professional publications. Equally important, however, has been the work of the great teacher, G. V. Black, and the cast inlay process introduced by William H. Taggart. About 1900 Europe again comes to the fore. The x-ray is a German invention (William Conrad Roentgen). Cocaine was developed in Vienna by Carl Kohler and credit for the recognition of focal infection belongs to an Englishman—William Hunter.

All this has been told before, but never completely or in proper sequence. Guerini's "History of Dentistry" is an excellent work, but it stops early in the nineteenth century, omitting the great development which has taken place within the last hundred years, especially in the United States. Dr. Charles E. Koch attempted to cover the American scene, but his two large volumes are little more than a Who's Who of men prominent in dental affairs. The historical material is incomplete and inadequate. A small but excellent volume on the "Folklore of the Teeth," by Dr. Leo Kanner, discusses only one phase of the subject, which is a very small part of dental history.

In presenting this unpretentious volume, therefore, I lay no claims to originality. I have not discovered strikingly new or original sources or material which has not been printed somewhere else. I do believe, however, that the history of dentistry from prehistoric times to the present has never been collected and presented completely in one book. This is the first time, too, that dental history has been treated in its relationship to the social and cultural environment. Most writers dealing with the subject have written of dentistry as though it had developed in a

vacuum, independent of outside influences. Yet, any historian knows that these influences were of tremendous importance; for example, the effects of frequent invasions in the near East, slavery in Greece, or the introduction of Christianity in the Roman Empire. Indeed without historic perspective, the progress of dentistry through the ages is difficult to understand.

The writing of this book was something of an afterthought. In a sense, my patients deserve the blame or credit for it. Often while I was standing at the chair, a patient would ask me questions that I was unable to answer; such questions as "Who invented the dental drill?" "How were teeth extracted before the discovery of anesthetics?" "Were crown and bridgework used in Ancient Egypt?" Disconcerted by my ignorance, I started to search for such information. My curiosity having been aroused, I continued until I had accumulated a rather voluminous amount of material on the subject. It then occurred to me that, in all probability, patients of other dentists were equally inquisitive and that many members of the profession would like to have these answers or might be interested in the history of their calling just as I was.

It was this thought which motivated me in organizing the material in book form. I have tried to avoid the errors often made by writers on subjects pertaining to dentistry. Dental books are usually too verbose and too expensive, and are often written without regard for the interest of the prospective reader. For this reason I have omitted much detail and have adopted a simple narrative style. This book is a brief story of dentistry, written for the rank and file and not for the chosen few. However, though the story is told in lighter vein, I have not deviated from the facts as I found them in the original sources. While presented in the form of a story, my unpretentious effort is nevertheless an authentic outline of dental history from the remotest times to the present day.

In sifting through the vast amount of material, I frequently found contradictions; dates when certain events were supposed to have occurred vary with different sources. My choice may not always have been infallible.

I have probably discarded some facts which I should have retained, and given prominence to irrelevent incidents. Frequently, too, in spite of my attempts at objectivity, my conclusions may not be entirely correct.

All these sins of omission and commission I humbly regret, and I hope that the critics will not be too unkind.

As I have pointed out, this book does not contain original material. I have borrowed freely from a wide number of sources, and I am indebted to many writers, far too numerous to mention, but I must make an exception of V. Guerini's "The History of Dentistry"; Dr. Leo Kanner's "Folklore of the Teeth"; Dr. Victor Robinson's "The Story of Medicine" because their works have been particularly helpful. To Dr. L. Pierce Anthony who wrote several of the biographies at the bottom of some of the portraits. These first appeared in the seventy-fifth anniversary issue of the *Dental Cosmos* and are here reproduced through the generosity of the S. S. White Co.

I also wish to express my gratitude to Dr. C. N. Johnson, lately deceased, for reading the chapters on anesthesia, to Dr. Arthur D. Black, who before he passed away went over the chapters on amalgam which deal briefly with the work of his illustrious father, to Dr. William J. Gies, for reading the whole manuscript and for his valuable suggestions; particularly for the revision of the chapters on the development of dental education, to my friends Drs. William H. G. Logan, Harold E. Smith, and Herbert E. Phillips for their encouragement and advice. I also must include my thanks and appreciation to Mrs. Josephine P. Hunt, the librarian for the American Dental Association, who has been ever ready to search for and supply the vast amount of material without which this book could not have been written.

M. D. K. Bremner

Chicago, Ill.

A comparison of the first dental college with the present modern dental schools.

The following story is often repeated in the Near East:

* * * *

A man saw a child weeping. "Why are you weeping?" he asked. "A snake bit me," was the reply.

"That is nothing," said the man, "I thought you had a toothache," and went his way.

Introduction

The Story of Dentistry is a history in which every practitioner should be interested. Dr. Bremner has treated the material at his disposal in such a way that it reads without effort. The early chapters record a great variety of superstitions and traditions and trace the dim and uncertain origins of science and art from superstition and charlatanism. It is always difficult for us to retrace the development of thought and think as men did in the past, but it may be quite possible that a hundred or more years from now things that we do will seem as crude and as much based on superstition as the things of the past do to us.

Especially interesting and important is the record of the effect upon the practice of the profession of such developments as the discovery of amalgam as a filling material, of vulcanizing of rubber, of making crowns and bridges, and the development of the inlay process, each of these methods greatly extended dental service to the population.

I was particularly glad to note that Dr. Bremner has devoted considerable space to the work and efforts of J. N. Crouse and William H. Taggart. Too much recognition and honor cannot be given by the dental profession of the future to these two great men. It would be impossible to overestimate the value of the services which they have rendered to the dental practitioners.

Both men made the same mistake: they counted on the gratitude of their profession and sacrificed themselves and ruined their practices in confident expectation that an enthusiastic profession would express its gratitude. Both men died in poverty. Professional ethics is a curious thing; perhaps it is not different from other ethics. While expressing the highest standards of relation of the individual practitioner to the community and to other members of the profession, the code of ethics has at times been utilized in such a way as to inflict cruelty on those who have rendered great services both to the profession and to the public.

Dr. Bremner recognizes this and he is not entirely unsympathetic to either Crouse or Taggart but, having been the organizer of the litigation that finally defeated the Taggart inlay patents, it is understandable why the unfavorable side of their activities should appear more serious to him than they do to me.

The Story of Dentistry will not only be profitable reading, but it will furnish many an evening's entertainment.

Frederick B. Noyes
Dean, College of Dentistry
University of Illinois

September 14, 1939
Chicago, Illinois

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CHAPTER I

DENTAL DISEASES ANTEDATE RECORDED HISTORY

Frequently on summer afternoons while drowsing in the forked limbs of a tall tree, Man looked longingly over the grassy plain toward the distant river which he could barely see at the edge of the horizon. From his vantage point the sunny land below seemed infinitely attractive. Yet, despite his curiosity, he never dared leave the shelter and safety of the forest, for with neither tusks nor claws, he knew instinctively that even with his superior intelligence, his puny strength was no match for the powerful and ferocious dwellers of the valley.

Then he discovered the club, a weapon which lengthened his arms and increased the force of his blows. Armed with the club, Man felt strong and unafraid. And so, one day when the plain looked particularly inviting, he climbed down from the tree, stepped into the sunlight, and started on his arduous journey toward civilization.

The club was probably an accidental discovery, like the finding of a burning stump or brush kindled by lightning. But the addition of a few fagots to keep the fire burning was a human invention. Later, Man learned to preserve the embers, and, finally, learned to make fire. This was without a doubt the greatest and most valuable of all the achievements during the years Man has existed on earth. Fire widened his food supply to a remarkable degree. Many things too tough for even the teeth of the prehistoric savage could be made edible after softening in the hot embers.

Another important result of the invention of fire was the increased use of fish as a staple of daily diet. Cooking and baking made sea food more tasty and more edible. With this readily available food supply it was easy for man to live along the water courses of the earth, and before the dawn of history we find him in the river valleys of Egypt and China.

Baking and roasting became the normal method used in the preparation of food. And, over a long period, through trial and error, mixtures and concoctions were invented that would tempt the eye and tease the palate. Man's diet is no longer limited to the forest fare of fruits, nuts and the flesh of small animals, for he has learned the food value of many root tubers, and the seeds of plants and grasses. Both in Egypt and China a considerable portion of the human diet consists of corn, wheat, barley and rice.

Apparently Man is thriving. But something has happened to his teeth and to his gums. The molars, which lasted his progenitors through their lifetime, are beginning to decay. His gums become soft, and are frequently inflamed. Painful swellings often develop on his face, and yet man's kin, the apes, who remained in the forest, have none of these troubles. Can it be possible that the combining of food stuffs, cooking, a predominantly starch diet are the cause of his dental maladies?

We cannot, of course, vouch for the story of Man descending the tree with his big club, ready to contest for mastery of this planet with the million or more other species that inhabit it with him. Maybe that is not how it happened; perhaps the account of the creation as taught in Sunday Schools is really the true explanation of Man's arrival on this earth. If so, the torture of the toothache must have been implied in the curse of Adam, for in the Egyptian manuscript known as the Ebers Papyrus, dating thirty-seven centuries before Christ, there are constant references to maladies of the gums, "blisters (abscesses), and gnawing teeth," as well as prescriptions for their cure. According to Biblical chronology, which places the creation of the world at about 4000 B.C., this Papyrus must have been written soon after that great event. Cain or Abel may have been suffering from an aching molar the very day the Lord served notice on the human family to pack up its fig-leaves and vacate the Garden of Eden.

The Chinese, too, about three thousand years before Christ, wrote extensively on dental diseases. In their writings, mention is made of nine varieties of dental ailments and seven prescriptions for their cure. Chinese doctors also advocated puncturing various parts of the body for the purpose of expelling the bad humors held responsible for many afflictions, and listed twenty different points of puncture for the cure of toothache.

Professor Olmstead, a well-known archeologist, reporting on an excavation near the Biblical city of Ninevah, that may be recalled in connection with the famous story of Jonah and the whale, refers to tablets written in cuneiform characters which record that a physician was called to task by a king for not curing him of his illness. The physician replied that if the king

would carry out his directions the fever would leave him. The directions were that the "burning which burns his head, his hands, and his feet, would be relieved by the extraction of the teeth." This physician was evidently far ahead of his times. For not until the end of the first decade of the twentieth century did the medical and dental professions recognize the intimate relationship between ill health and bad teeth. But apparently the advice did not cure the patient, the "burning" must have continued, since in another tablet, the same doctor suggests that "the month was probably not propitious." It was dangerous in those days for a king's doctor to commit an error of judgment, and he was trying no doubt to save his head. Let us hope he succeeded.

There is an unfounded popular belief that all savages and barbarians were strong and healthy. Actually, "the natural man" who roamed the forest, without an ache or a pain, was a mythical figure invented by Eighteenth Century philosophers. Recent investigations of ancient skeletal remains prove conclusively that primitive people were anything but healthy. In actual or real life, ancient man suffered from many of the diseases which torment us today.

Early humanity also had its share of dental ills. Toothache predates recorded history. Ancient petrified skulls furnish ample evidence that cavities in the teeth and gum abscesses existed from remotest times. Fourteen per cent of the skulls of the Danish Stone Age had carious teeth. The cave skulls in France showed numerous cases of decay. Among the earliest Egyptians, caries was comparatively rare but became more prevalent as their civilization advanced. During the reign of the Ptolemys, and later at the time of the Byzantine Empire, it was almost as common as it is today. Explorers who opened some large aristocratic tombs in the Gizeh pyramid, found nearly five hundred skeletons which showed evidence of decay and pyorrhea. These and many similar archeological findings amply support the statement that:

"Decay of human teeth from ancient times have been found in so many places that it is legitimate to doubt whether there was ever an epoch when the human species was not cursed with toothache."

CHAPTER II

BAD TEETH A HUMAN AFFLICTION

Diseased teeth, which has plagued the human race and often made life a torture to mankind, would have been disastrous to the animal inhabitants of the forest or jungle. In the fine balance which exists everywhere in Nature, the disadvantages of bad teeth would soon tip the scale against a species and decrease its chances of survival. Fortunately for them, animals are immune to dental troubles so long as they remain in their native state. Only those creatures closely associated with man have shared this affliction with him. For example, the dog, a meat-eater by nature, descendant of the wolf, the jackal and the fox (all carnivora), often forgets his evolutionary history and develops a fondness for candy and other things which are not good for him. The punishment for his transgressions is bad teeth.

The proud cat, too, though more fastidious in her food habits than the dog, is nevertheless not immune to dental ills. As a household pet she is tempted to eat food contrary to her physiological requirements. Bread and milk are not on Nature's menu for the feline. Some veterinarians claim that Maltese cats are particularly susceptible to decay. Their explanation is that the profusion of hair which is characteristic of these animals, extends to their tongues. The fine hair on the tongue retains particles of food in contact with the teeth; an argument for oral prophylaxis.

The horse, in old age, often requires the services of a horse dentist, through no fault of his own. While roaming the range, feeding on the grasses which pastures provide, his teeth never bothered him. But along with his enslavement came changes in his diet. Putting the horse to work, Man found that food of greater caloric value, such as oats, would increase the horse's endurance, enable him to work longer and carry heavier burdens. Constant chewing of hard grains wears his teeth down, sometimes to the

pulp, causing painful abscesses and swollen jaws. This also accounts for reports in the newspapers every once in a while of elephants being treated for toothache, probably because a zoo cannot duplicate the jungle food best suited to the pachyderm. Only grazing cattle that eat almost the same kind of food on which they had subsisted before Man stole their freedom, alone of all Man's animal associates, have retained their good teeth.

In the human race decay seems to increase with civilization. Ninety per cent of the population of Western Europe, of the Antipodes and of the United States suffer from dental diseases. In the poor neighborhoods of New York City investigators have found that more than half the children two years of age have decayed teeth and the percentage increases with age. If the experience of wild and domesticated animals is of any value, then it would appear that diet may be the cause of our dental ills. That, too, may explain why civilized peoples whose food is more varied and complex have a greater susceptibility to dental diseases than simpler living groups.

Bad teeth may be one of the penalties which the human race must pay for constantly changing its habits and modes of living. It may be the result of our more or less successful attempts to control our environment which is the great difference between men and all other creatures.

Of course most animals seem to have some ability of adaptation. We are all familiar with the migration of birds to escape the rigors of northern winters. Naturalists have cited some striking adjustments which certain creatures make to altered conditions of sustenance or climate. But no animal has ever been able consciously and purposefully to control its environment. When conditions of life became too unfavorable and the battle for existence too difficult, most creatures perished, joining the millions of extinct species unearthed by geologists all over the world. Man alone was the exception. He not only had a better brain but he could stand and walk erect. This trick, which he learned in the infancy of his evolution, liberated his fore legs for the more specialized function of arms and hands. With these aids man acquired a control of his fate which no other species ever attained. Changes of climate, drought or any other caprice of nature might make his life hard and unpleasant, but could not annihilate him. If the plains became arid and the desert sands filled his wells he traveled long distances, scaling mountains and crossing wide rivers on rafts or in dugouts until he found a better location where conditions were more favorable and life was easier. When the temperature fell he built a fire in front of his cave or covered his nakedness with the pelts of his fur bearing neighbors and waited until the sun shone again.

It was this special ability to adjust himself readily to changing conditions in his environment which made it possible for man to inhabit every part of this earth, on mountain tops, in valleys, near the poles, or at the equator. Everywhere, he managed to live and even to make himself comfortable. But, there was a price to pay for this. The changing environment often compelled a variation in diet, which may have been responsible for his bad teeth, since food probably determines not only the hardness and softness of our teeth but also the condition in which they remain throughout life.

It is hardly necessary to cite examples showing how geography or climate may effect our every-day diet. In the far North the Eskimo lives mainly on seal meat and blubber, which his location provides. Milk and its products were unknown in Mexico or Peru in pre-Columbian days for there was no tameable cattle on the American continent. The Mayan and Aztec civilizations were built on corn. The Chinese cultivated rice-plants; rice was and still is the principal diet of the inhabitants of the Yangtze River Basin. The ancient Semites and Aryans, progenitors of the Western peoples, were pastoral. Father Abraham and the children of Israel followed their cattle over the grass lands of the Fertile Crescent, subsisting mostly on meat, milk, and milk-products. When the Western peoples settled down, and their civilization became agricultural, they too, like the Chinese and the Central American natives, began to follow a predominantly starch-containing diet. The Indians of the North American prairies hunted the bison, and with the exception of the few berries and roots picked during the summer season, lived mainly on meat. Along the sea coast in places like Japan or the Pacific Islands, fish is the great food staple.

Drinking water found in various regions is another environmental factor in determining the quality of the teeth. In some parts of the world, the soil contains certain minerals which affect the teeth of the inhabitants. Districts as widely separated as the Azores Islands and Northern China show the same peculiarity in drinking water evidenced by the large number of children whose teeth erupt with mottled or imperfect enamel. This condition is also prevalent in our own West, particularly in Colorado and Arizona. It has been very definitely proved that in any region where the water contains more than one in two million parts of fluorine, mottling will occur in the teeth of growing children up to the age of about eight or ten. Mottled teeth have also been produced experimentally on rats.

But mores, taboos and traditions have often influenced man's diet to

even a greater extent than have his physical surroundings. These determine the use which he makes of the materials at his disposal. We shall mention just two examples in our particular field.

The Egyptians always crushed their grain in stone mortars, which was a technique of their culture. Fine particles of sand became mixed with the meal. As a result, their teeth wore down to the nerves, causing abscesses which discharged pus through the jawbone. Many of the skulls found along the Nile show the perforations caused by those pus-draining fistules quite definitely. The Eskimos of today suffer from the same condition but from a different cause. In their case, the teeth are worn down from chewing on hard bones and from the use of the teeth for the softening of animal pelts of which their clothing is made. This condition is said to be more common among the women because they are the tailors in the Eskimo family.

There are other factors also that determine the type and quality of our diet, which for lack of a more accurate term, may be classed as psychological. Man has always been adventurous; he chafes under monotony, dislikes the repetition of stereotyped actions and is always seeking new sensations and new experiences. Seldom is he satisfied with himself; even with his own body. His hair and his complexion have been a source of endless experimentation. All over the world, different peoples have painted their faces and tattooed their bodies, using all colors and all possible patterns. In the same manner, they have widely varied their haircuts from time to time and in different localities. Sometimes they wear it pompadour fashion; at other times they part it in the middle or plaster it down with grease or red clay. Occasionally, to suit esthetic tastes men have maimed their bodies by knocking out a few front teeth or punctured a hole in the septum of their noses, to accommodate sticks or shells. To this very day, some of our women perforate their ears from which to hang ornaments. Until very recently the Chinese bound the feet of their daughters, crippling them so that they were unable to walk, because unusually small feet were considered beautiful.

Man has adopted the same attitude toward his diet. He has experimented with the odor and the taste of his food, creating various mixtures and concoctions. He has discovered condiments, such as salt, pepper or paprika with which to season his food. Sugar, alcoholic beverages, wines, spirits, and beers are all the product of this search for novelty. The human diet has become more attractive and more varied, but the results have not been always beneficial. White bread made of flour from which the husks

have been extracted is inadequate food even for rats. Discarded vegetable peelings contain valuable mineral elements. Concentrated sugar is a man-made product, and some authorities believe that this in itself, consumed as it is in large quantities by Western peoples, may be responsible for our bad teeth. In manipulating his food, man has often destroyed these recently discovered substances—vitamins, which are recognized as playing an important part in the development of the teeth, and in protecting them against decay.

A striking effect of cultural behavior on the teeth is well illustrated by the case of betel-nut chewing. This nut, the fruit of a palm tree, native to the Malay Peninsula is extensively cultivated over a wide area in the East, including Southern India, Ceylon, Siam and the Philippines. Nearly one tenth of the human family indulges in this habit. A small piece of it is wrapped in the betel-vine, together with a pellet of shell-lime. The Malays have practically no caries, even though they are fond of sweets and eat mostly rice and other starches. The explanation may be that the alkalinity of the lime and the astringent properties in the nut act as a prophylactic and preventive.

We would not, however, recommend the chewing of betel-nuts to the American people. It is a very unesthetic habit. The mastication causes a copious flow of saliva which becomes brick red in color and dyes the lips, tongue and gums.

CHAPTER III

MAGIC AS A CURE FOR TOOTHACHE

One peculiar characteristic of man is his ability to fool himself, to lie to himself, and then to believe in his own lie so fervently that he is willing to give his life for his belief. It is this strange propensity for believing in his own imaginary creation that has enabled man to snatch victory out of defeat, and to thrive in spite of the powerful natural forces which constantly threaten his very existence. If the thunder-clap frightened him and the lightning struck close to his cave, man invented a "god of thunder" and certain rites for appeasing him. When the river broke its bounds, inundated his fields and drowned some of his children, man created a river god, and to propitiate that god's wrath threw his first-born into the turbulent waters. Then he assured himself that this great sacrifice would find favor with the angry power that attempted to destroy him. He believed the god smiled upon his sacrifice and listened to his supplication and because of that belief in the protective power which he himself had created, he took new courage, rebuilt his home and raised a new crop.

Ignorant of physiology, pathology or the part played by micro-organisms, mankind believed that all pain and affliction were sent by evil spirits or offended deities. This belief was shared by all primitive people. If a god or a demon disliked an individual he made that person sick. The Greek gods were very liberal with visitations of illness and mutilations of offenders.

Based upon this supernatural explanation of disease, man sought relief from aches and pains by appeasing the anger of gods or demons who tormented him. Thus various types of magic became the accepted curative agents amongst all tribes and amongst races everywhere.

The most widespread of all magical cures were those related to the

sun. It is easy to understand why this particular agency, the sun, was assigned so many powerful attributes by primitive people. Man, from his early existence, has been fascinated by the sun; that bright object on the horizon, the source of light and heat; the sun which causes vegetation to grow, which warms and invigorates the body, and dispells the fear of darkness and of night. This great planet, the giver of life, the source of all blessings and of all goodness, naturally became the center of primitive man's magical system, and was relied upon to cure his ills and his pain, dental aches included.

A simple illustration of the connection between the sun and the healing of disease is the mythological sun-god Apollo, who was also the god of healing and was further supposed to have been the father of Aesculapius, the god of Medicine.

A very important magical element in the cure of diseases was the spoken word in form of charms, incantations, or exorcisms, sometimes written on a piece of paper, stone, or wood.

Belief in the great power of the spoken word is universal. Ancient man must have been impressed by the faculty of speech, which he alone possessed. He probably came to believe that this remarkable faculty had some special mystical qualities, which could influence the unseen forces that controlled his life, and might also serve to relieve his sufferings. The earliest toothache cures are, therefore, word charms with the sun as the central theme.

But the real foundation of most magical systems is belief in the sympathy of relationships. It begins with the idea that whatever has been a part of the body continues to possess the body's properties, and may therefore represent it for magical purposes. This is carried further to include resemblances, both physical and functional; objects that look or function alike are assumed to be in the sympathetic relationship. For this reason, mice and other animals, reputed to have strong teeth, played an important part in ancient tooth remedies. Nevertheless sympathetic magic does not explain all the magical formulas which have been used by primitive peoples for the relief of toothache.

For example, the mouse was commonly venerated, and seemed to be one of those objects related in some way to the sun. The Egyptians believed the mouse to be under the protection of the sun, and an antidote against death. The popular cure for toothache among them was to split the body of a mouse and apply it while still warm to the gums over the offending tooth.

The early Greeks, too, connected the mouse with the sun. Apollo, the sun god, was also known as the mouse-god. In one of the temples of Apollo a figure of a mouse was placed upon the altar. The Greeks also believed that the mouse was valuable in relieving oral difficulties. A prescription popular in Greece for halitosis about the fifth century B.C. runs as follows:

"the head of a hare, three mice from one of which the intestines have been removed, but not the liver nor the kidney; these to be burned separately, the ashes triturated with an equal amount of marble dust mixed with water."

The following quotation from Isaiah LXVI, 17:

"They that sanctify themselves, and purify themselves in the gardens behind one tree in the midst, eating swine's flesh, and the abomination, and the mouse, shall be consumed together, said the Lord," would indicate a mouse worship cult in ancient Judea.

The belief in the mouse as an aid to good teeth still endures in some of the less civilized portions of the earth today. In Mexico, in southern Russia, and in other countries, they drop the shed tooth of a child into a mouse hole, saying:

"Mouse, mouse, give me your iron tooth for it, and
I will give to thee my bone tooth."

In the Pacific Islands this becomes:

"Big rat, little rat, here is my old tooth.
Pray, give me a new one."

But, though this practice may be related to sun worship, it is also possible that it is merely a form of sympathetic magic. The mouse, or rat, is reputed to have strong teeth. The contact of a child's tooth with the hole where the animal lives, or even a charm containing the name of the rodent may have been thought to bring similar properties of strength to the teeth of the child. Many early peoples believed that the name of an individual was intimately connected with him and became a part of his body like his hair or his nails. For this reason they frequently were called by a supplementary nickname, and would refuse to divulge their real name for fear that it might be used by an enemy in connection with some magical formula, to cause them harm. The name "rat" or "mouse" in the various charms might therefore have been used as a substitute for the animal itself and thus be in sympathetic relationship with the teeth of the child.

There are some instances, however, where a direct sun worship in connection with the teeth can be definitely recognized. For example the peasants of Lebanon throw their teeth against the sun, exclaiming:

"Sun, sun, take the ass tooth and give me a deer tooth."

Among other tribes the same practices may be observed in the use of

certain plant remedies, such as the chewing of evergreens, particularly the laurel, sacred to Apollo, the sun god, for the relief of the toothache. The ivy, sacred to Osiris, was commonly used in the Nile Valley for the same purpose. Incidentally, there is an old story current in Christian countries during the Middle Ages that St. Peter once had a very severe toothache and the Lord said to him: "Take three ground ivy plants and hover them about thy mouth." Very likely this is a remnant of the old pagan belief.

Diseases of the teeth were sometimes attributed to the worm, the enemy of the sun. In the Babylonian legends, Tiament, the worm, is an enemy of Samas, the sun god.

The earliest toothache charm in existence runs like this:

"When god, Anu, created the heavens, the heavens created the earth, the earth created the rivers, the rivers created the canals, the canals created mud, the mud created the worm. The worm went along at the sight of the sun, it wept. His tears came before the face of the god, Ea, 'What do you give me for food, and what do you give me for drink?' I give you the wood, Ea, which is right; 'What's that to me rotten rood, Ea! Let me settle down in the interior, the tooth and give its flesh for lodging. From the tooth I will suck its blood, and from its flesh I will break its roots.' 'Because you said this, worm, god Ea may strike you with the strength of his hands."

A rather interesting charm used by the Maori natives of New Zealand runs as follows:

"Sprouting seed, sprout
Sprout, that you come
To see the moon, now full,
Come you sprouting seed
Let the teeth of the man
Be given to the rat,
And the rat's tooth
To the man."

There have been any number of charms used throughout Europe where the moon played the central role. This may be because the sun and moon were often worshipped together. For instance in Greek mythology Arthemis the moon Goddess had the healing of diseases as one of her many attributes and the ancient Egyptians sacrificed pigs to the moon. In some parts of the world, even today, the use of moon charms for toothache is not at all rare. Most of them, of course, are remnants of medieval superstition. Here is one example:

"Dear moon, I complain to thee
Toothache and bad demons torture me,
Take from me, take to thee,"

or

"Light moon, green leaves, roots in the world,
(Here the teeth are seized)
Take the toothache dear, thou shalt cheat
And not heat:
I greet thee, light bright, for the teeth
And the Gout;
For the little red worms that got in the teeth."

The worm superstition persisted for many years.

Medical men throughout the Middle Ages believed that decay was caused by worms in the teeth. The primitive belief of the worm representing the evil spirit was later transferred into the scientific fact (?) that worms caused decay; this ancient superstition was accepted as true until not so long ago; in fact as late as the eighteenth century, Dr. Fauchard devoted several chapters of his book in an effort to discredit the worm theory of tooth decay.

Today it seems odd that some physicians did not attempt to verify this explanation by trapping a few of the worms. However here is another and even more striking example of the medieval mind. Four hundred years before Christ, the famous Aristotle, although an accurate observer, fell into the error of believing that women had fewer teeth than men. This belief was commonly accepted until recent times. And we naturally wonder why, in all those centuries no one took the trouble to count the teeth of a number of men and women to check Aristotle's statement.

Religion occupied an extremely important position in the life of the people during the Middle Ages. Naturally, therefore, we find appeals to the saints entering prominently in the charms that were used to relieve toothache. The following is a simple example:

"Si + Sa + Anna + Si + Sa + Anna."

St. Anna is referred to in this formula, which was inscribed on a piece of paper and hung on a string around the neck of the sufferer. But the reference to the Saints is more evident in the following:

"There were three saint women.
The first was Anna, the second Susana,
The third Sybil, toothache keep still."

Another formula also worn around the neck with St. Peter as the active agent was quite common in the Middle Ages. This probably originated in the following story:

"St. Peter sat on a stone and held his cheek in his hand. There came our Lord and said unto him 'Peter what hast thou?' St. Peter said, 'Sir, the worms have got into my teeth.' The Lord said 'I conjure your teeth in the Name of the Father, the Son and the Holy Ghost that there will be

no power in the future to dig in Peter's teeth. Ayos, Ayos, Ayos, Tetramaton. If you wish to banish the toothache, tell the one who has the pain to write on his cheek the words, rex, pax, rax, in Cristo Filio Suo.' "

But Susanna, Anna, and Peter were not the only saints called upon to intercede for toothache sufferers. One lady, who, because of her own experiences and sufferings made toothache her special concern, deserves special mention. Her name is St. Apollonia. The story told about this saint is as follows:

In the year 249 A.D., in the city of Alexandria, a virgin of advanced age was imprisoned for becoming a Christian. Her teeth were broken with sharp iron points and the roots were extracted with tongs. During her terrible agonies, she prayed to the Lord that any person suffering from toothache, who would invoke Him in her name would be relieved immediately. The prayer was answered by a voice from Heaven saying: "Bride of Christ, thou hast obtained from God what thou hast prayed for." Later when her tormentors offered to spare her life if she would renounce her newly-acquired faith, she refused, preferring the death of a martyr. And it was said that five hundred people who witnessed her fortitude and her martyrdom immediately joined the new religion.

St. Apollonia became the patron saint of dentists and dentistry and as the years passed her story became embellished. She became a young and beautiful maiden, the daughter of a senator. Then her father was changed into an emperor, thus making Apollonia a princess. Most of the paintings and statues depict her as she appears in the latter version of the story.

Throughout the Middle Ages a number of churches were built and shrines erected in honor of this saint, where many of her teeth were preserved as holy relics. Judging from the molars, centrals and cuspids exhibited at the different places, it would seem that the martyred lady must have had at least half a dozen sets of teeth. How the poor saint must have suffered! No wonder that she chose toothache as her special field of operation. Several incantations or word charms for the relief of toothache invoking her name, have come down to us, like the following:

"Apollonia, Apollonia,
Holy saint in heaven
See my pain in yourself
Free me from Evil pain
For my toothache may torture me to death."

This was supposed to be especially effective if pronounced on her day, the ninth of February.

The name of Apollonia resembles very much the pagan god, Apollo, who was in the habit of doing chores for the ancients, and in whose honor the eleventh of February was celebrated, just two days later than that of dentistry's patron saint. If there had not been five hundred witnesses present at the event of her martyrdom in Alexandria on the ninth of February, 249 A.D. we might be inclined to suspect that this is an instance where the Great Church, unable to suppress the pagan deity, compromised with a deeply rooted ancient belief.

Another method by which early man sought to relieve his pain was to transfer it to some other object, usually a tree. The common practice was to cut a sliver of the bark from a tree, jab the gums with it until they bled, and replace the blood-stained sliver in the same spot on the tree. In some countries, a nail, preferably from a coffin, was used to draw blood and then hammered into the tree. It was assumed that the evil spirit was captured in the blood, and that if the nail or sliver were fastened to a tree the evil spirit could not return to the sufferer.

During the Middle Ages the nail was preferred to the sliver in such cures, for it symbolized the nails of the Cross of Christ. The Romans used the oak, because they worshipped that tree. The ancient word charms that accompanied the practice before Christianity were later replaced by Pater Nosters and other prayers. But in some parts of Europe old pagan incantations still survive:

"Nail, I complain to thee
My tooth, it bothers me
In me it leaves
In thee it stays
It won't have anything to do with me forever more."

and another:

"Toothache, flee at the second stroke
Toothache, cease at the third stroke
Toothache stay away."

Often the toothache was transferred to running water. The sufferer went to a well, took a mouthful of water, held it for a while, spat it out into the well and repeated the following lines:

"I go to the ground
Take water in my mouth
And keep it in my mouth
And spit it again into the ground
So my teeth in Jesus' may be sound."

This last charm probably originated in the commonly observed fact that cold water will often stop a toothache in its early state.

We may smile indulgently at all these superstitions. It is, however, well to remember that magic fitted in with man's conception of himself and the world around him. Believing that his ailments were of supernatural origin, it was both reasonable and logical that the remedies which he sought should be also supernatural.

ST. APOLLONIA, THE PATRON SAINT OF DENTISTRY

The above is a photographic reproduction of the famous painting of Carlos Dolci (1670) which hangs in the Corsini Gallery of Rome, Italy. She is reputed to have espoused the cause of Christianity as the only religion that could satisfy and ennoble her life. She was persecuted for her faith, and in punishment for her refusal to renounce her religion her teeth were removed, one at a time. Upon still refusing to renounce her religion she is said to have been burned to death. She was canonized as Saint Apollonia in 300 A.D. for her martyrdom, and for a period of some 1600 years her intercession has been sought for the relief of painful dental diseases, particularly toothache.

Lower jaw of Egyptian who is supposed to have lived several thousand years ago, showing perforations that must have been caused by pus boring through, probably the result of dental abscess.

CHAPTER IV

STRANGE SUPERSTITIONS ABOUT THE TEETH

We have discussed the magical cure for toothache prevalent among the ancients and have seen how these cures were related in their minds to the enduring quality of the sun. However, not only the cures for toothache, but the actual teeth themselves were often connected by the primitives with the great planet. This was probably because the teeth persisted long after the organs and the bones of buried bodies disappeared. The apparent indestructibility of the teeth linked them up in the imagination of the early peoples to the most permanent everlasting force in the universe—the sun.

The necklaces of teeth worn by the chiefs of primitive tribes, circular in shape and resembling the sun were very significant pieces of jewelry. Usually the number of teeth in those circles was ten, and occasionally twelve, suggesting the signs of the zodiac. A pendant when added was generally a cuspid, very likely because of its phallic symbolism, which in the fertility rites are always connected with sun-worship. The famous tooth enshrined and worshipped on the island of Ceylon is a cuspid. According to tradition it was preserved for eight hundred years in India. Presumably, it was one of the relics which was snatched from the ashes of Buddha after his cremation. It was brought to Ceylon in 311 A.D. In August of each year there is a great religious ceremony at the shrine of this tooth.

The veneration of the teeth led to many queer superstitions. The tooth of a dead man who had died by violence, or better still, of a criminal who had been executed, was supposed to possess special merit as a toothache remedy if applied to an aching molar or to a swollen jaw. Some claimed that the best time for this was just at midnight when there was no moon, while others held that the charm worked better during the full

moon. Such teeth were also considered effective talismans against the loss of generative powers and headache. The teeth of almost every known creature were said at one time or another to possess miraculous power. For example, a mad dog's tooth was protection against hydrophobia. The tooth of a hyena, especially if pulled from the left side, was recommended for colic or abdominal pains. Wolves' teeth were hung from the necks of horses for the purpose of preventing fatigue.

These and similar beliefs can easily be explained on the basis of sympathetic magic. Primitive man was sure the attributes of the whole existed in each of the parts as well. It was, therefore, a natural conclusion that the hyena thriving on carrion must have a good digestion and hence its teeth, therefore, would relieve a stomach ache. The same type of reasoning would apply with equal force to the teeth of wolves, because they were tireless when hunting their prey. Their teeth would, therefore, aid the endurance of horses. Similarly we may explain the use of the teeth from a black dog by thieves on their errand of burglary, to keep the dogs of the household from barking at them; the presumption being that the black color of the dog would confer invisibility upon the thief.

There are other charms however that are not so easily explainable. In some places the teeth of a dead fox were believed to be effective against sleep walking, those of dogs for jaundice and of tigers for whooping cough. It is equally difficult to explain the use of a youngster's first shed tooth for the relief of uterine pains, or why a molar from an old woman when planted in the field will increase the sweet potato crop. We simply cannot fathom the working of the primitive mind. Even the mental processes of less primitive peoples are often rather strange. For example in many parts of Europe, until a short time ago, it was believed that putting on the right stocking before the left or getting out of bed left foot first would insure protection against toothache.

During the million years of evolution, nature developed a routine for tooth eruption. This may have been sheer accident or it may have had a very definite survival value which cannot now be recognized. Normally a child's first tooth appears between the fifth and eighth month. Those on the lower jaw come first. Once in a while a child is born with a tooth. More rarely, with two teeth. Or, the order of eruption is sometimes reversed, the upper teeth appearing first. Today we do not consider these slight abnormalities of any importance, but primitive people are always afraid of the unfamiliar, even a break in the regular occurrence of natural phenomena disturbed them. Most abnormal happenings were feared as

precursors of danger, against which protection must be sought at all cost. For this reason in some parts of Africa a baby born with one or more teeth is believed to be a menace to the welfare of its family and tribe; therefore, it is drowned at once. The same fate befalls the child who cuts his upper central teeth ahead of the lower ones. In Madagascar, such children are taken out into the forest and left there to be devoured by wild animals. In India they are also done away with because it is believed they will bring calamity to the maternal uncle. In remote parts of Hungary these children are called "changelings." They are believed to be witches' children and are usually treated unkindly. Among some Arabians the Koran is read before the baby born with teeth, and he is made to move his head affirmatively which means that he has taken a sacred oath to harm no one.

Even in Shakespearean England there remained ancient superstitions concerning such babies. In Richard III we find:

"That dog that had his teeth before his eyes
To worry lambs and lap their gentle blood."

This means that he possessed teeth at birth, before his eyes were open. There is another reference to it in Henry VI:

"The midwife wonder'd, and the women cried
O Jesus, bless us, he is born with teeth,
And so I was; which plainly signified
That I should snarl and bite, and play the dog."

In some parts of the world where nature is more kind, man's superstitions seem to have been more benign. In Rome, if a child came into the world with teeth, the event was considered important enough to confer an epithet on him. At least two Roman senators are said to owe their surname, "Dentatus," to such prenatal teeth. Even more recently in Latin countries this phenomenon was considered a sign of a brilliant future. We are told that Louis XIV, "le rois soleil," was born with three lower incisors, which gave his wet nurses a great deal of trouble. The same is said of Mirabeau and Mazarin.

The eruption of the first teeth is usually a trying time for most children. Many infantile ailments have been blamed on the cutting of the baby teeth. This normal physiological process has been a matter of great concern among all races from time immemorial. In some places the parental interest begins very early. The bride, or the future mother, saves some of the bread from the wedding feast to use later for rubbing the children's gums to make their teeth cutting easy. In other places, the christening water at the baptism

is applied to the gums. Sometimes amulets are hung from the baby's neck or placed in his cradle under the pillow. The great variety of objects used for this purpose in different parts of the world at different times is far too numerous to mention. They are all distinguished however by their oddity and strangeness. Man not only fears the uncommon and unfamiliar, but he also has endowed such things with magical virtues. Among gum applications we find blood from the comb of a black cock, or the tail of a white cat, brains of a hare, paws of a toad, and objects of a similar nature. The same idea seems to prevail in connection with most of the amulets. The teeth of animals were generally most popular, particularly those of the wolf, the shark, the wild boar, and other creatures that had a reputation for strong teeth. But no animal has been overlooked. Usually rarity conferred special attributes and snakes' teeth were often considered more effective than those of rats and mice.

Incidentally, it is curious how often the mouse turns up in connection with the teeth. The peasants of Franconia make an amulet for teething, by biting off the head of a live mouse, which is put into a linen bag and hung around the child's neck. The biting must be done by one of the parents. According to one writer, babies of ancient Rome were fed on house mice in order to relieve them of the pain and the itching which accompanies teething. Pliny, the Roman writer recommends eating a mouse twice a month to prevent dental ills. These practices are perhaps explainable on the theory of sympathetic magic.

Of course we no longer kill babies born with teeth, yet the western world is not entirely free from superstition on this subject. Early teething is still considered in some European countries as a sign of premature senility.

The Germans and Italians have a saying, "The one whose teeth grow early will sink into his grave," and in Northern England this same idea is expressed: "Soon teeth, soon toes."

Other harmless superstitions can be found in various lands. The person whose teeth are far apart is destined to travel far. Irregular teeth denote fickleness. Large broad teeth are a sign of sensuality. In Switzerland, a wide space between the upper incisors indicates that the child will become a great singer. In Italy the same is a sign of good luck. An Arabian prayer reads: "Allah, protect us from a beardless man who has blue eyes and teeth that stand far apart."

All of these superstitions suggested to an enterprising Frenchman the introduction of a new "science" which he called "Odentological physiog-

nomy." The professor claimed that he could read the characteristics and future of people from the way their teeth were arranged. For a while he enjoyed the patronage of a large clientele. Such credulity may seem odd to most of us. Still, many people shape their lives by horoscopes published daily in our newspapers. There is not much difference between the two.

CHAPTER V

MAGIC VERSUS DRUGS

No human institution has ever succeeded or endured unless it had some real merit. The universality of magic and its persistent use in the treatment of disease is sufficient proof of its great value to humanity. There was plenty of evidence that magic actually worked; that it could be depended upon to cure and to relieve. The "shaman," or witch-doctor, could point to many patients who had become well under his ministrations. Since the body has within itself recuperative powers and the ability to heal itself, nature assisted the ancient practitioners just as she does our present day doctors. Of course, there were many failures, but nothing is ever one hundred per cent. The inadequacy of some present day physicians does not discredit the practice of medicine.

Another reason for the success of magic in the treatment of the sick was due to the fact that some diseases are often of a mental character. Hysteria is a common example. Although the malady is altogether mental, the patient is able to simulate symptoms of any number of ailments, and quite frequently deceives himself and everybody else around him. In such cases, ministering to the mind is very important. Magic did this very thing and therefore helped many whose ailments were functional and not organic. The reputed cures credited to shrines and the faith healers of today are said to be of the same type.

The ancient medicine man must, however, have had difficulty in treating dental diseases. Cavities in molars are not self-healing. The body has no means of repairing a broken tooth, as it does a broken leg. One would hardly acquire a painful abscess by imagination. "Malicious animal magnetism" has never been accused of causing a cavity in a central, and absent treatment has never stopped the agony of an inflamed dental pulp.

Magic must have failed too often; and the ancient healer was forced to find some other means for relieving dental aches and pains. It is probably a safe guess that the inclusion of certain substances, for their material rather than magical attributes in the treatment of disease, originated in the attempt to find some agent to stop toothache after magic failed.

Throughout the ages, mankind has pursued a steady and intensive search for some material or drug which would bring relief from the dreaded and agonizing pain caused by cavities in the teeth. Dr. Kanner in his admirable book "The Folklore of the Teeth," lists sixteen inorganic remedies, one hundred and thirty-two remedies taken from the plant or vegetable kingdom, fifty-four from the animal kingdom and nine from human excretions, making a total of over two hundred. In their various mixtures and combinations they would run into many thousands which have been used in different parts of the world, at some time or another by different peoples as toothache medicine. Most of the remedies were absolutely useless. Probably each was first used merely as an experiment, and if by some chance the pain passed away while the supposed remedy was being applied, it immediately gained an undeserved reputation.

Many of the useless remedies had only the qualities of rarity, strangeness, or unusual nastiness. The last of these probably has certain magical connection. Asaphetida, the offensive smelling juice of a plant which has been so fittingly called the "polecat of the vegetable kingdom," is a striking example of this. It is undoubtedly the most malodorous stuff that can be found. Its use was probably based on the assumption that the odor would be so objectionable to the evil spirit, that it would flee in disgust and leave the poor patient alone. This drug has absolutely no value. If it ever succeeded in helping anybody it was perhaps due to the fact that the smell annoyed the poor sufferer so much more than the toothache that he forgot his pain. Among other rather odd prescriptions used for the relief of aching molars may be listed the milk of an ass, powdered glow-worm, the eyes of a vulture and human ear-wax. Mankind has always been fascinated by the bizarre and the unfamiliar.

Of course, after so many experiments the ancients were bound to stumble on some really valuable agents effective in the stopping of toothache. In addition to the absurd and peculiar remedies, they were also familiar with and used thymol, ginger, oil of cinnamon and several others of equal value, some of which are found quite useful in dental practice today. But magic was not discontinued and for many centuries supernatural remedies held sway in the treatment of dental and all other ailments.

CHAPTER VI

EGYPT, THE NEAR EAST AND CHINA

The man who first applied cold water to his fevered brow, and repeated the application because it gave him some relief, discovered the value of material agents in the treatment of disease. But it took thousands of years for the accumulation of organized medical and pharmaceutical knowledge. Early man had no time, in his nomadic life, either to observe accurately, or to develop any method for recording whatever observation he made. Some knowledge was handed down by word of mouth, but the human brain is inaccurate and memory imperfect.

However, some time before the dawn of history, a few tribes wandered into the fertile, pleasant valley of the Nile. At regular intervals the great river overflowed, fertilizing and irrigating the surrounding soil. It was possible to settle down and grow an abundance of food without much effort. Eventually the more capable individuals managed to achieve a position of wealth and power, and to organize a society on a plane which enabled them to live on the toil of others. Thus there developed in Egypt a leisure class of priests and nobles.

The priest class in Egypt devoted itself to study and learning. Some concentrated on the observation of natural phenomena. They were familiar with some of the stars and with some of the natural forces on the earth. In time, the discovery was made that water in which a certain gum was dissolved and soot added would leave black markings on papyrus. The marshes of the Nile were abundant with this papyrus, later recording of knowledge was facilitated by the simplification of the earlier hieroglyphics. One of the earliest surviving records, the Ebers papyri, dates back to 3700 B.C. These are without doubt the most voluminous and best preserved writings on medical and dental subjects that have reached us from that remote past. They are to be found in the University of Leipzig.

By that time the humble beginnings of early Egyptian medicine had long been forgotten, and the priests who were the chief practitioners claimed that their skill and information came directly from the gods. All diseases and human afflictions were attributed to demons and evil spirits. These were unusually powerful in ancient Egypt, so that even the gods themselves did not escape their visitations. The benevolent Isis suffered with an abscess on her breasts and the great sun-god Re himself was smitten with an eye disease. And although the priests relied on magic for their cures it did not prevent them from experimenting with some natural remedies, such as opium, castor-oil, salts of copper and of metals and several drugs which are still being used today.

There is no special chapter dealing with dental diseases in the Ebers papyri, but remedies for the treatment of the teeth are found scattered among prescriptions of an altogether different nature. Poultices for face abscesses are followed by salves to cure the itch, mouth-washes for inflamed gums are preceded by suggestions for the reduction of fever and the cure of baldness. Some of these prescriptions were totally absurd. Others were very useful and effective; for example, ground incense or cloves for toothache relief, crushed horse-radish and garlic for gum boils and poultices made from dough and honey to reduce swellings about the face. These could be used by dentists today.

In earlier times dentistry must have been a part of the general practice of medicine. But in the 5th century B.C., Herodotus, the Greek historian writes that, "in Egypt, medicine is practiced on a plan of separation, each physician treats a single disorder and no more, thus the country swarms with medical practitioners, some undertaking to cure diseases of the eye, others of the head, others again of the teeth." This is the first record that we have of dentistry being practiced as a distinct specialty. Such practice, however, must have been limited to the stopping of toothache and simple extraction. For, while in these papyri there is considerable discussion of operative intervention such as the use of the knife in the opening of tumors and the application of the red-hot cautery, there is only slight reference to extraction and no mention whatever of artificial dental restorations. It is fairly safe to assume that Pharaohs' daughters must have suppressed their smiles if they were unfortunate enough to lose their front teeth. Archaeology has not produced evidence of mechanical dentistry in ancient Egypt.

The fertile crescent, that plain at the edge of the Arabian Desert, watered by the Tigres and Euphrates Rivers, is the second important focus

of civilization of the white races. Here the Sumerians, Babylonians, Assyrians and Hebrews struggled for supremacy thousands of years ago. On this plain, conditions were not favorable for the preservation of skeletal remains, as they were in the Nile Valley where the soil was dry. Nor did the religion of these people stress the preservation of the body against the day of resurrection. They did not mummify their dead. We have, therefore, few skulls or jaws from which to draw definite conclusions about the condition of their teeth. The cuneiform tablets previously referred to would indicate that they knew something about the extraction, and their explanation of tooth destruction by the worms shows quite definitely that they were familiar with tooth decay. Beyond that we have almost no information.

In the code of Hammurabi, King of Babylon, enacted two thousand B.C., we read; "If anyone knocks out a tooth of his equal, his teeth are to be knocked out." The even handed justice of a tooth for a tooth apparently existed before Moses. "If he knocks out a tooth of a freed man, he is to pay one miné of silver. If he knocks out an eye he is to pay two minés." These people must have thought a great deal of their teeth, since they valued an eye only twice as much as a tooth. Were their teeth so universally perfect that the loss of any one tooth was considered so grave an injury? Or perhaps good teeth were so rare that a single perfect one was worth half the price of an eye! The ancient Hebrew law was that if a master knocked out a servant's tooth, the servant gained his freedom, even if the tooth had been loose before.

The Yangtze River Valley, like the fertile plain in Asia Minor and the Nile Valley in Northern Africa, also offered conditions favorable for the early development of a highly organized society. The Mongolians built a civilization here which the Chinese claim is older even than that of the Egyptians. This may or may not be true, but if there is any connection between dental diseases and civilization, these people must have developed their culture at least thirty-five hundred years ago, because manuscripts which the Chinese attribute to that period describe practically every disease of the teeth and gums known today. Chinese physicians recommended several prescriptions for toothache, inflamed gums, and dental abscesses. Some of them are interesting, such as saltpeter and garlic made into pills, one of which is inserted into the ear on the side where the pain is; garlic and horse-radish triturated with human milk, a small pellet placed in the nostril on the opposite side of the aching tooth, a medicated powder used by women in the left nostril and by men in the right. The simplest mouth-

wash suggested is the urine of a child, the age limit not given. One of the causes of toothache is supposed to be the result of general weakness, caused by over-indulgence in sexual pleasures. A little white worm with a black spot on its head is said to be responsible for the holes in teeth. One of the prescriptions for toothache has as its main ingredient the bones of mice. Thus the symbols of sun-worship appear again, far from Asia Minor or Egypt. Of course, it may have been only sympathetic magic.

Until recently dentists in this country employed arsenic to kill pulps before extirpation. This drug was also known to the early Chinese who used it extensively to stop toothache. They did not know of course that the relief of pain resulted from the death of the pulp and later the putrified tissue probably caused the teeth to abscess. This may account for the large number of swollen jaws and abscesses from which those people suffered. As late as 1850 the dental profession knew no more about the effects of this dangerous drug than the ancient Chinese, and were equally careless in its use. The Chinese manuscripts also mention scarification and the lancing of abscesses. The Chinese practiced extraction to some extent, but there is no evidence of any mechanical dentistry or of artificial teeth.

Thus far, it is quite evident that the progress of dentistry through Northern Africa, Asia, and the Near East was very insignificant. Even the clever Egyptians did not fill teeth or replace lost ones with dental bridges or other appliances. Excavations in Asia Minor have revealed no dental forceps. And neither the Chinese manuscripts nor the Ebers papyri refer to extraction at any great length.

In view of what we know about the savage tribes in Australia, South Africa, and the Pacific Islands, who practice the removal of the teeth as a sign of mourning or as a tribal ceremony at puberty, this apparent ignorance on the part of highly civilized ancient peoples may surprise us. We must remember, however, that there is a great difference between extracting a perfect tooth from healthy gums and a broken tooth or root from inflamed gums. Most savage tribes knock their teeth out with a hard wooden peg which they strike with a stone mallet. Even today, with improved skill, anesthetics, and all our modern equipment, the removal of a broken down tooth is not a simple task.

CHAPTER VII

THE GREEKS AND THE ETRUSCANS

The ancient civilizations became decadent after a number of years, and their progress stopped. The further growth of dentistry was inevitably affected. In China, perhaps because of the rapid increase of population, men were so occupied with procuring food to put between the teeth that the condition of the teeth themselves sank into insignificance. In Asia Minor, the constant repetition of new invasions and the influx of nomadic tribes from the Arabian deserts made it impossible for organized society to maintain itself long enough to develop the useful arts to a very high degree of usefulness.

The Egyptians, of course, were the most highly favored. The Nile Valley was fertile, and the desert on either side of the river protected them from invasion. With life both easy and peaceful, they excelled all their contemporaries in mechanical and artistic creations. Unfortunately the priest-physician was a poor combination. Gradually the priestly attitude became dominant and magic replaced the rational treatment of diseases. The latter medical writing contains more magic and less medicine. Although they eviscerated millions of bodies on the embalming table, the Egyptians knew very little anatomy and the numerous perforations of the jaw bones found in the mummies indicative of dental abscesses is evidence that their knowledge of pathology was rudimentary. Egyptian medicine did not progress beyond a certain point. At some time in their history these gifted people stopped learning, perhaps because their philosophy had run off on a tangent. By some strange reasoning they arrived at the belief that the body is resurrected and the soul returns and inhibits its old home. And for many centuries these able people devoted the most of their wealth and all their skill and attention to the preservation of the dead. They built

pyramids and furnished them with all the necessary objects which the dead were supposed to require in their long journey until the day of resurrection. This devotion to the dead may explain why the Egyptians never developed artificial dental restorations for the living. Whatever the cause, the continuation of our story is transferred to Europe and to a new race.

The contribution of the Greeks to dentistry was mostly on the medical side. An ancient Greek physician, Aesculapius, gained great fame among the people for his medical knowledge and skill. In time he became deified, and was given Apollo, the Sun-god, as his father. Many wonderful tales are told of his accomplishments. Among other things, as well as the art of bandaging wounds and the introduction of purgatives, Aesculapius was credited with the cleaning of the teeth and mouth. And, most important, the extraction of teeth.

If accounts are correct, Aesculapius lived between 1200 and 1300 B.C. Many temples were built and dedicated to him all over Greece. The sick came for help to these "Aesculapii" and the priests alleged direct descent from the great physician. One of the most celebrated shrines was at Cos, the birthplace of Hippocrates, "the father of medicine" who lived in the 5th century B.C. and was supposed to be the nineteenth or twentieth descendent of the first doctor. He became famous both as a practitioner and as a writer on medical subjects.

Hippocrates emancipated medicine from the gods, eliminated magic from the treatment of bodily ailments, and recognized that nature alone heals; that the physician is only her assistant. He raised the art of medicine to a level which has been attained only in recent times. Many of the latest discoveries have confirmed his methods and it is not so very long since his books have ceased to serve as texts in the schools. His compendium on dentition consists of thirty-two paragraphs, and it may be regarded as the first treatise on the disease of children. It exhibits, in brief form, his extensive knowledge of the subject.

In the works of Hippocrates, there is no one chapter devoted especially to the teeth, but from many passages scattered throughout the collection it can be deduced that the great physician recognized the importance of the teeth and their maladies. Neither Hippocrates nor others before him had done any dissecting of the human body. The Greeks in those days held the dead in great veneration and for this reason it is not surprising that Hippocrates erred so often in his opinion about the anatomical structure or the physiological functions of the human body. Nevertheless, he was a very keen observer, and knew a great deal about the formation of the teeth before birth from studying animals. He was also familiar with the diseases of dentition, and other ailments of the mouth and gums.

One of his prescriptions for the trouble about which "your best friend will not tell you" reads as follows: "Oil of anise seed and myrrh, two obloes (one and one-half grams); each substance immersed in half a coytle (one-eighth of a liter) of white wine," as a mouth wash for halitosis. This was probably better than most of the nostrums which advertisers frighten the public into buying today.

In his book "De Carnibus" (Old English translation from Latin) Hippocrates, "ascribeth the cause of their hardness to the quality of the matter out of which they are ingendered, for he writeth that out of the bones of the head and the jaws there is an increase of glutinous matter. In that glutinous matter the fatty part falleth downe into the sockets of the gums where it is dryed and burnt with the heat, and so the teeth are made harder than other bones because there is no cold remaining in them."

This fantastic physiology of 500 B.C. is duplicated in the following quotation from a book published in London 2100 years later (1618, to be exact) by Helkiah Crooke, Doctor in Physicke, "That they (the teeth) are bones some men deny, first, because bones are insensible, the teeth sensible. Secondly, because the bones have certain limits of action or increase, neither do they ever grow againe if they perish, but in teeth it is quite contrary. Thirdly, because they are harder than other bones. Fourthly, because their whiteness—finally, say they, there is a stone that will consume fleshe, called therefore Saccophagus, which within forty days will devour the whole body except the teeth. If therefore the teeth were of the nature of bones, they also would be consumed.

"They were made very hard that they might not weare so soone or be broken in the chawing or breaking of hard things, for they are not lined either with fatte or gristles as other joints are to hinder attrition. The teeth therefore do breake bones, resist the edge of steele, neyther can they easily as other parts of the body be burnt with fire."

In the opinion of Hippocrates, teeth erode and become decayed partly by the insinuation of secretion under the roots and partly by food, "when they are by nature weak and badly fixed in the gums." Not evil spirits, but natural causes were responsible. This rational opinion regarding the possible causes of diseases lasted for several hundred years among intelligent Greeks and Romans, until superstitions took control of man's mind again and kept him in darkness for more than a thousand years. Hippocrates advised the removal of decayed teeth if they were loose, and for teeth which were decayed but not loose, he suggested dessication with a cautery.

Red-hot wire inserted in the tooth; an heroic measure. But that was the age of heroes.

In the reduction of fractures of the lower jaw, Hippocrates advises that the parts be held in juxtaposition by the binding together of firm teeth on each side of the lesion with linen thread or gold wire, and he says that loose teeth in such cases should be supported by similar ligatures. Two Greek appliances for the support of loose anterior teeth assigned to the third or fourth century B.C. are preserved in the Archeological Museum at Athens. One consists of gold wire and the other of a gold ribbon.

A more interesting specimen than the above, belonging to the same period, now in the Louvre at Paris has been found in one of the oldest tombs at Saida (ancient Sidon) on the coast of Phoenicia across the sea from Egypt. This specimen consists of six lower anterior teeth fastened together with gold wires. Two of these teeth from which the roots have been removed apparently belonged to another person. The wire is passed through holes in these teeth and wound around the natural teeth holding them in position. Such appliance may be considered one of the first attempts in the construction of bridgework although it does not necessarily exemplify the state of the art. It might be nothing more than an isolated inspiration of an ingenious mechanic. We can readily imagine that even a savage on a level of culture far below the Phoenicians heartily tired of his toothless face, tried to fill in the vacancy by tying a few animal or human teeth with the aid of a grass ligature or a piece of gut.

Hippocrates was evidently familiar with some kind of forceps for the extraction of loose teeth, for he writes "as for the pincers in pulling teeth, any one can use them, for the method in which they are employed is quite easily apparent." Difficult extractions were probably not attempted in his day, for lack of efficient instruments. Later, in the time of Aristotle, 384-322 B.C., extraction had become more common, because dental forceps must have been improved. For in his mechanical problems, Aristotle writes, "dental forceps are constructed of two levers acting against each other and having a single fulcrum," which is similar to the present type of forceps. An instrument after this description, made of lead, was deposited at the temple of Apollo at Delphi, possibly as a votive offering. But it may also have served as a model for duplication in iron.

According to Aristotle, "figs and soft sweets produce damage to the teeth because small particles adhere between the teeth where they very easily become the cause of putrefactive processes." That is an almost up-to-date explanation of tooth decay. Aristotle was primarily a meta-

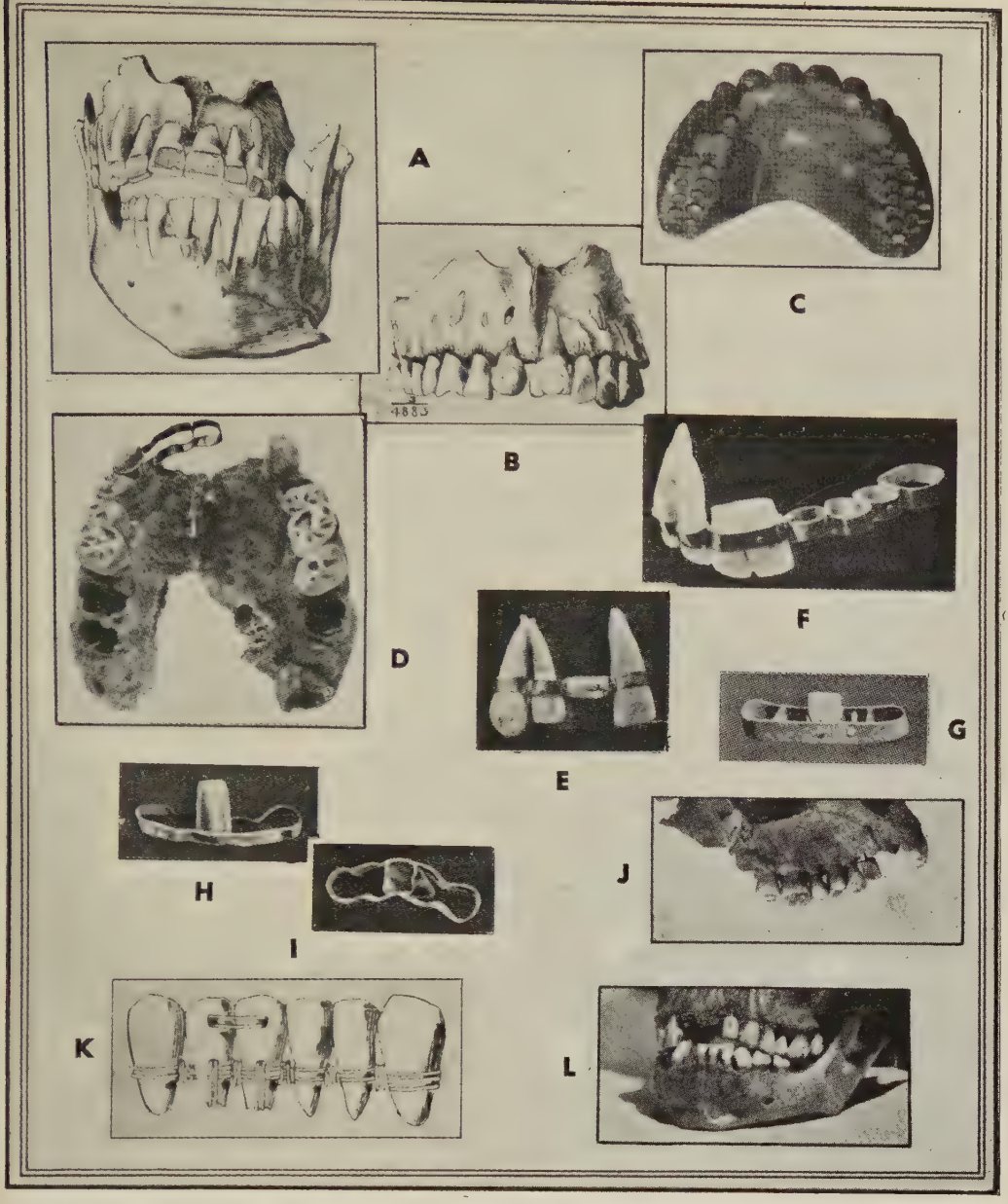
physician which accounts for so many errors that he has been guilty of. For example, the theory that fleas arrived from filth, that plant lice are born from dew that forms on vegetation or that women have less teeth than men. One well known author on the history of medicine thinks that Aristotle would have been a much greater scientist if he had spent one year with Hippocrates instead of twenty with Plato. Unfortunately the great physician passed away when Aristotle was only fourteen years old. Still, he was one of the greatest men the Greeks produced. There was practically no field of knowledge in which he did not blaze a trail and for many centuries his were the only firm foot-steps in the path of science.

None of the Greek writers on the subject alludes to mechanical restorations or fillings. The few specimens of Greek dental art that have been found are crude and insignificant. This may be due to the fact that the Greeks, living the simple life, had fairly good teeth and dental maladies were so uncommon that there was no great need for artificial substitutes. Yet it is unsafe to explain cultural patterns on the basis of need. There are far too many instances where both the need existed and necessary materials to supply it were available and yet certain tribes continued to live as their forefathers had done, without change or improvement in their mode of living.

A well known example is the case of the Yhagans who live on Tiera Del Fuega at the tip of South America. When the whites first found them they were walking around naked and built their houses of a few branches covered indifferently with seal skins. Although the climate reaches an average range of about 20°F. and few days of the years are free from wind or snow, yet fur bearing animals were plentiful and the forests quite extensive.

It is equally unsafe to conclude that the highest culture will always develop at the point of greatest contact between peoples, since contact facilitates borrowing and rapid interchange of ideas. If this were true, we might expect that the Phoenicians, the great traders of the ancient world, living in the center of the African and Eurasian civilizations, would have excelled all other races in the art of mechanical dentistry. But, actually, it was the Etruscans (who flourished in Central Italy, in Tuscany, from 1000 to 400 B.C.) who made the greatest contributions in the dental field.

There are numerous specimens of gold crowns and bridges in Italian Museums which are the equal of any made in Europe or the United States up to the end of the last century. A very unusual example is a bridge made about twenty-five hundred years ago, consisting of several gold bands



A. Fragment of an ancient skull with the six upper anterior teeth prepared for gold inlays, one of which is still in place. (From Esmeraldas, Ecuador.) B. Round inlays from Ecuadorean skull. The inlays were made in artificial cavities, which were produced by some kind of stone implement. C. Old Japanese upper denture, with black anterior teeth, all carved of wood, in one piece, except metal tacks that serve for posterior teeth. Anterior teeth much worn. In the U.S. Army Medical Museum at Washington. Misc. Ser. 73. (From J. A. Taylor, "History of Dentistry," p. 32, Fig. 8.) D. Etruscan gold appliance for supporting loose teeth, sixth century B.C. (From V. Guerini "History of Dentistry," p. 75, Fig. 22.) E. Etruscan gold bridge, not removable, upper for one pontic with rivet, sixth century B.C. (Sudhoff, ed. 2, 1926, Fig. 44.) F. The earliest extant block of teeth. Two upper central incisors carved from a single tooth of an ox or calf. On an Etruscan gold bridge denture, light type. Before 500 B.C. (Sudhoff, Fig. 46.) G. Etruscan gold bridge. Removable, lower, for two pontics with rivets, seventh century B.C. (Guerini, Fig. 18.) H. and I. Gold crown, with supporting loops of gold. Roman, period of the Empire (27 B.C.-476 A.D.). (From Guerini, Fig. 31.) J. and L. The earliest extant tooth, with a supporting wire. Assigned to the Merovingian Kingdom of the Franks (420-737 A.D.). In the Museum of Metz, France. Labial and palatal views. K. False teeth fastened in with gold wire. Found at Sidon, Phoenicia, and perhaps 3400 years old. (Oldest piece of dentistry in existence.)

fastened to the natural teeth and supporting three artificial teeth, two of which were made from one calf's tooth ingeniously grooved in the center, simulating the appearance of two natural upper incisors, and the third a human tooth. The historian Dr. Guerini, who duplicated this particular specimen, found that it required a tooth from a fetal calf to reproduce the width and thinness, indicating the high level of ingenuity possessed by these early dentists. Another Etruscan dental restoration of later date consists of several gold rings soldered together, which embrace four lower teeth (a cuspid, two bicuspids and a molar), the second bicuspid, now lost, having been an inserted tooth secured by a rivet. Still another specimen is formed of two gold ribbons soldered together, one on the labial and one on the lingual side, with partitioned pieces between the surrounding teeth, all of fairly heavy construction. It embraced four lower incisors and a bicuspid; two of the incisors, one of which is still in place, secured by rivets extending through them. There are a number of other partial dentures of bridge work type made by the Etruscans scattered through Italian museums.

Did all these fine appliances originate with those clever people inhabiting the hill country of the Italian peninsula? In view of our knowledge of the constant borrowing which went on among different people, it is more than likely that the Etruscans borrowed some of their dental art from their neighbors, and later improved upon it. The now extinct Cretans may have made some contributions in this field. Who knows? Even so, we can no more explain the progress of dentistry among the Etruscans than we can account for the art of Florence in the latter part of the fifteenth century, the poetry of Elizabethan England, or the music in Central Europe from Bach to Wagner.

There may be one reason that would account for the contrast between the dentistry of the Greeks and the Etruscans. Human progress is the accidental appearance of gifted individuals in an environment favorable for the exercise of their talents. Under adverse conditions, the abilities of the greatest genuises are likely to remain stillborn. In ancient Greece, which was a slave holding society, a Greek citizen considered it beneath his dignity to use his hands except for the creation of beautiful objects. All manual work was relegated to the Helots. Seneca said "that inventors were not geniuses, but that their devices were the products of the lowest minds."* To use one's head with one's hands in the making of useful articles was thought degrading; an occupation fit only for slaves. Under such dis-

* Note, Seneca was a Roman but the same attitude prevailed among the Greeks.

couraging conditions it is easy to understand that dentistry could make little progress.

In Tuscany, on the other hand, there were comparatively few slaves. Manual and digital skill were freely exercised by the people and mechanical ingenuity was highly appreciated. As a result, they developed a number of useful crafts including dental appliances.

CHAPTER VIII

THE ROMANS

Good teeth were highly esteemed by the Romans as a sign of health and vigor. A Roman wag ridicules an old patrician dandy "who picks his toothless mouth with a tooth pick to give himself the air of the man not too far stricken in years." A popular curse for an enemy was "may your teeth turn black." An entirely perfect set of teeth seemed to have been as rare in ancient Rome as in New York today. Decay and pyorrhea were probably as prevalent among the Latins then, as in the United States at present, and they were no wiser regarding the causes than we are.

Some Roman writers attributed this condition to the large consumption of tablets made from poppy-seed and honey, the Roman equivalent of our candy. Others, like Celsus, the famous writer on medicine who lived about 100 B.C., believed that dental diseases were part of the general physical deterioration. According to Celsus, "perfectly healthy and strong people would not even need to wash their teeth with fresh water." In his opinion "intemperance and idleness brought upon the Roman population a host of evils so that in spite of the introduction of medicine few attained the beginning of old age."

Although Celsus writes as a physician, it is not certain whether he recorded his own findings, based upon experience in the pursuit of his calling, or if he was merely a complier and translator of Greek manuscripts. One fact, however, is certain. Celsus was a true disciple of the great Hippocrates. Like the Father of Medicine he refused to accept the popular explanations regarding the causes of disease. He knew that it was not offense against the gods or the displeasure of evil spirits but the infraction of nature's laws that was responsible for human ailments. Charms and magic therefore had no place in his system of therapeutics. Only drugs and other material agents, such as heat or cold, he insisted, might aid in the cure of disease.

Celsus's writing on dentistry is most extensive. No one before him (and not for several hundred years after) treated the subject so rationally and in such detail. "In toothache which may be numbered among the worst of tortures" he devises a pepper-berry or mustard seed placed in the cavity. For dental abscesses hot-water fomentations to the face, counter-irritants to the gums, and "also a purge may help." To keep the patient comfortable and enable him to get some sleep, Celsus recommends several prescriptions which contain among other ingredients, narcotics such as opium and mandrake. For diseases of the soft tissues, he recommends astringents like alum, nut-galls and in some cases the searing of the gums with a cautery. The present use of electro-coagulation was in a measure anticipated by the great Roman.

If teeth were badly broken down and had to be removed, Celsus advised packing the cavity with lint or lead so that the crown would be less likely to fracture. However, he is hesitant about extraction excepting as a last resort, probably because he had no faith in the skill of barber-surgeons. Only in extreme cases does he suggest the removal of broken roots and mentions an instrument for that purpose, which the Greeks called "Rizagra," probably an elevator.

Celsus' treatment of jaw fractures was quite modern. He advises ligating the teeth with silk ligature and reducing the swelling with hot-water fomentations, and feeding the patient sparingly on liquids until the fragments have united. When a permanent tooth appeared before the fall of the milk tooth, Celsus recommended "to dissect the gum all around and extract it. The other tooth must then be pushed by the finger day by day towards the place that was occupied by the one extracted, and it is to be done until it has firmly reached its right position." This is perhaps the first record of a method for tooth straightening or orthodontia.

Several other Roman writers have referred to dental diseases and their treatment but they either repeated what Celsus had already recorded or else drifted into supernaturalism, advocating remedies that he would have ridiculed. The following is an interesting example. One physician suggests that "whilst in the open country one must take a frog by the head, open its mouth and spit into it, then having begged the animal to take the toothache with it, must replace it on the ground and let it free."

Galen, who next to Hippocrates, is considered the greatest physician among the ancients, was the first to recognize or at least to mention the presence of pulps within the teeth. He also observed that toothache can be of two types; in the tooth itself or in the jaw bone at the end of the

roots. Galen believed that caries started as a result of the disturbance of the humors inside of the tooth. Some dentists still entertain this explanation of tooth decay, and not many years ago several articles appeared supporting this theory. Altogether Galen's contribution to dentistry was insignificant.

The appreciation of good teeth led many patrician families to employ special slaves for cleaning their mouths. This was done with small sticks of mastic wood, an evergreen common along the Mediterranean, from which these slaves received the name of "Mastiche." The oral hygienist may therefore be considered of ancient origin and prophylaxis not a new idea. Tooth powders made of fine pumice, burned eggshell, burned stag's horn, were very popular, and decoctions of bay-leaves, myrrh, and hebana (night-shade) were quite commonly used. But along with these and other useful preparations, we also find powders from burned heads of mice, the livers of lizards, and a mouth wash made from earth-worms steeped in vinegar. Urine was still considered a good remedy to strengthen the gums, and so, besides other aids to beauty, patrician ladies included on their dressing tables, an onyx bottle with the urine of an "innocent boy."

The Romans were great administrators and road builders but not specially gifted with originality in the arts. They borrowed their medicine, including dental therapeutics, from the Greeks and their restorative dentistry from the Etruscans. The First Greek physician settled in Rome about 218 B.C. For a long time the Roman population was suspicious of the newcomers, Cato, the censor, accuses the Greek doctors of poisoning their patients and warns his son not to have anything to do with them. After the Roman conquest of Greece, 146 B.C., this attitude must have changed, for the city became a lucrative field for Greek doctors.

The art of mechanical dentistry must have been acquired by the Romans much earlier, for Cicero quotes an ancient sumptuary law, the law of twelve tables, dating from about 450 B.C., forbidding gold to be placed in the grave with the body excepting the gold used for the fastening of teeth. This is understandable since Etruscans were Latins and close neighbors of the Romans. An appliance constructed of six light gold wire rings, three of which secured human teeth (two lower centrals and a right lateral) was found in Teano, southern Italy, which probably belongs to the third century B.C. or earlier.

In the early days of the Republic, such an ostentation as gold teeth was very likely frowned upon, but by the time of Octavius and through the prosperous days of the Empire until the death of Marcus Aurelius, the

Roman people went in for good and luxurious living, and dentistry as a part of personal adornment must have been in great demand. A dental restoration made about 100 A.D. which was found in some of the ruins includes a very nicely shaped incisor gold crown with two bands on each side of it. The crowns seemed to have been fitted to a natural tooth and must have helped to retain the other teeth in position. Judging from this and numerous other specimens it is evident that dentistry in Rome was developed to a very high level. Indeed not until late in the nineteenth century did the dentists in this country surpass the skill and ingenuity of the dental practitioners along the Tiber. If borrowing is one of the main causes of cultural development, then the progress of dentistry in ancient Rome resulting from the combination of Greek knowledge and Etruscan skill can be considered a valuable example.

Artificial teeth which could be removed must have been fairly common among the upper classes, for numerous allusions to them appear in contemporary literature. To quote at random:

"At night she lays down her false teeth, just as she does her silken robe."

"Thais has teeth so black and Leacania so white. Seek you the cause. Leacania's teeth are bought while Thais wears her own."

"Aegle thinks she has teeth because she bought bone and ivory."

Unfortunately we have no description of such appliances, because dentistry in Rome was not practiced as it is today. The Latins in fact had no special word for dentist. Physicians or barber-surgeons probably did the treatment and extraction while goldsmiths and other artisans must have supplied the artificial restorations. Since the latter were usually uneducated men who could neither read nor write, their work remains unrecorded. Roman manuscripts dealing with medical subjects fail to mention dental appliances, because restorative dentistry in Rome was entirely decorative and not related to health. The patricians had their teeth fixed solely for esthetic reasons. They wanted false dentures to improve their facial appearance and not as an aid to digestion. Celsus, who refers to many diseases of the mouth and their treatment, never even alludes to the mechanical substitutes which were surely popular in his time. He was no more concerned with such things than a medical man today would bother to discuss wigs, monocles or costume jewelry.

Beginning about 200 A.D. the great Empire started to decline. Roman economy which was built on slave labor could no longer maintain itself. The wealthier classes became impoverished and Roman society had more

important things to worry about than a few missing teeth. With the disappearance of the demand, dental skill gradually deteriorated and when the weakened state was finally conquered by barbarians, dentistry shared the common fate of all Roman culture.

But another, and perhaps more important cause of the decline of dentistry in ancient Rome was the rise of Christianity. Out of all the cults that came to the great city—the Egyptian Apis, the Persian Mithras, and other mystery religions—none were as successful as the simple summons, "Come unto me all ye that labour and are heavy-laden." There was a promise of consolation and new hope in this gospel that came out of the hills of Judea. Before long, Christianity increased its numbers and strength until its power overshadowed that of the emperor, and eventually it was the only force able to save some of the fragments of the old civilization from destruction by the invading barbarians.

But the meekness and the humility which promised a measure of peace on the shores of lake Galilee, was ineffective in the larger life of the big world. The simple faith of the new converts did not lighten the "burden of the heavy-laden." The lowly did not inherit the earth. When the Roman state organizations began to break up, the life of the average individual became more and more unsatisfactory, the missionaries of the new faith were hard pressed for an explanation. Finally the idea grew that the promised peace was not for the here and now, but for the hereafter. Like the Egyptians the Europeans began to focus their attention on death. Only the soul and not the body became their main concern, so instead of building pyramids they founded monasteries. Men and women in all walks of life concentrated their thought on the problems of sin, judgment day, and after life. Sack cloth and horse hair became a desirable garb and the hermit who never took a bath the most respected citizen. For over a thousand years this world was looked upon as a vale of tears, where poor humanity with the curse of Adam on its shoulders had only one aim and one object, to atone for the original sin and prepare its soul for eternity.

Health cleanliness and adornment of the body were considered sins of the flesh which might jeopardize man's place in heaven. Under these conditions who would pay attention to his molars? For what shall it profit a man if he gain a few artificial teeth and lose his own soul? As a result of this philosophy and attitude toward life, it is hardly surprising that dentistry became a lost art.

CHAPTER IX

THE ARABIANS

History sometimes plays strange pranks. The very religious fanaticism which almost expunged every vestige of Greek culture in Western Europe helped to sow the seeds in the East which later blossomed into the Renaissance and came to fruition in our civilization. It started during the fifth century, when heresy hunting became a very popular pastime in Christiandom. The most noted of the early heretics was Nestorius, patriarch of Alexandria. Cyril, the head of the church at Constantinople, decided that his Egyptian rival was becoming too powerful and must be eliminated. He accused Nestorius of heresy, and being a good politician, he was able to manipulate the synod of Bishops at Ephesus so that Nestorius and his followers were banished to Arabia and ultimately to the great Oasis of Egypt.

After many adventures, the Nestorians finally found a haven in Jundisapur under the protection of Chosroes the Blessed (531-579), King of Persia. There in the strange land, among strange people, shorn of power and separated from their church, the Nestorians devoted themselves to the revival of Greek culture. They translated Aristotle and Plato and founded a medical school where the precepts of Hippocrates were taught and practised, and Jundisapur became a great center of medical education and Greek philosophy.

About a century later Mohammed, having gained sway over the minds of the tribesmen inhabitating the Arabian desert, galvanized them into a conquering horde. After his death, with sword in one hand, and the Koran in the other, they quickly acquired mastery over large parts of Europe and Asia.

When, however, the lust of conquest had spent itself, the Arabians became aware of the Greek culture in Jundisapur, and like the early Romans fell under its influence. The conquerors were conquered by the ancients. Greek science and philosophy spread throughout the Moslem world, so that while the Europeans were ransacking Palestine for holy relics the Mohammedans searched for manuscripts which they translated into their own language. Arabic thus served as a depository for Greek learning and later through Latin translations Western Europe regained acquaintance with its own ancient civilization and laid the foundation for the Renaissance.

Arabian contributions to medicine, particularly in the field of therapeutics and pharmacology, were most noteworthy, "They fostered the early steps in chemistry, discovered nitric acid, aqua-regia, red precipitate, corrosive sublimate, and either introduced or popularized such important drugs as camphor, rhubarb, senna, nox-vomica, nut-meg, musk and cloves, and gave us syrup, jullip, alkali, and alcohol." Sulphuric ether was also discovered by an Arabian although its anesthetic properties were not recognized until several hundred years later. Unfortunately, the strict religious code, absolutely prohibiting dissection of the human body, sterilized their progress. The knowledge they possessed of anatomy and physiology remained limited to what they had learned from the Greek and Roman manuscripts, and they accepted all the errors of the ancients as authoritative information. For example, Aviecenna (11th century) who was called "Prince of Doctors" repeats Galen's opinion that "human teeth without antagonists will continue to grow just like the teeth of some rodents—squirrels." Of course both Galen and Aviecenna had mistaken elongation for growth.

For many centuries anatomic dissections were also prohibited throughout Europe and it is one of the strange inconsistencies of the human mind that the very people who had fostered the inquisition and had no compunctions whatever about the mutilation of the living with thumb screw and rack were very much concerned about the dead and ready to burn at stake any physician who tried to perform an autopsy.

Arabian doctors added comparatively little to dental knowledge. Their toothache remedies and gum astringents are similar to those employed by the Romans at the time of the Caesars. Many of them believed that odontalgia was caused by worms and that dental abscesses were due to an excess of "humors" which must be evacuated either by the application of a leech to the gums or else drilling into the tooth. In general the Arabians preferred the cautery to the scalpel and like the ancients were hesitant about

extractions and preferred drugs which would make the tooth fall out by itself; among these arsenic packed around the tooth. There is no doubt that this drug was effective but we can readily imagine the cases of necrosis of the jaw bone that followed the application of this powerful agent to the soft tissues.

Credit for outstanding contribution to dentistry in that period must be given to Abulcasis, who was essentially a surgeon. That probably explains his keen interest in everything pertaining to the teeth. While most of his writings were not entirely original, he may nevertheless be considered the great exponent of dentistry in the Middle Ages. In his book we find what is perhaps the first illustration of dental instruments. A set of fourteen scalers, a cautery with a tube for protecting the tissues, dental saws and files, instruments for loosening the teeth before extraction, elevators for the removal of broken roots and extraction forceps. Most of these appear rather crude and extremely inadequate. We must bear in mind, however, that these illustrations have been copied and recopied numerous times by different scribes before the introduction of printing so that what we see now may be only caricatures of the originals.

Abulcasis describes in detail the use of gold wire to stabilize loose teeth, operations for dental irregularities and replanting. He was a pioneer in discussing oral deformities and the formation of tartar. Less explicit however is his reference to mechanical dentistry, although he tells that, "spaces left by missing teeth can be filled up with artificial ones made of ox-bone, such teeth can be anchored by suitable gold wire to the natural teeth, they will be found of esthetic and functional value." He gave no descriptions of such appliances and as in the case of the Romans the craftsmen who made those dental substitutes were not the type of men who would leave written record of their art. Physicians like Abulcasis were not interested in the subject; it was out of their field.

Almost without exception every Arabian physician writing on dentistry attaches great importance to clean teeth. Abulcasis describes very minutely the scaling and the removal of calcareous deposits. Mouth washes and sundry dentrifice powders were quite popular. Instead of our present day tooth brushes the Arabians used a small polishing stick beaten at one end and the fibers separated into a brush which they called a "siwak."

It seems that the oral hygiene movement in Arabia was originally started by the great prophet himself. One of his commands was "you shall clean your mouth for this is a means of praising God." He also said "a prayer which is preceded by the use of the toothpick is worth seventy-

five ordinary prayers." The emphasis on clean teeth may of course indicate a great appreciation of oral prophylaxis. But, from what we know about the life and habits of the early Arabians, and about Mohammed himself, such an assumption would hardly be warranted. In all probability the teeth cleaning mandate was not prompted by a desire to save the teeth of the faithful, but more likely it may have been related to veneration of the teeth which we have previously observed as quite common among many people in different parts of the world; a manifestation of sun worship. A definite example of such connection is the tooth-brushing ceremony practised by the natives of Hindustan, particularly by the Brahmin priests, who rub their teeth with a cherry wood stick while facing the rising sun and recite prayers invoking heavenly blessings.

Mohammed may have found this practice among the sun worshipping tribes of the desert and without knowing its origin or understanding its meaning or its purpose, included it among the numerous commandments which he imposed upon his followers. The Koran is a mixture of pagan beliefs intermingled with Judaism and Christianity.

CHAPTER X

THE MIDDLE AGES IN EUROPE

Nothing happened in dentistry during those many centuries commonly called the "Middle Ages" that is worth recording. We could well skip the entire period from the fall of Rome to the sixteenth century without the least detriment to our story.

After the passing of Galen, the rational practice of medicine and dentistry built up laboriously by Hippocrates and his followers in Greece and later in imperial Rome started to retrogress until it practically vanished, and throughout the western world, supernaturalism once again became the common explanation of the cause of disease. Illness and plague were accepted as punishment inflicted by the Lord for the infraction of his commandments as interpreted by the priests, and earnest prayer was recommended as a sure and unfailing remedy.

Monotheism had, of course, eradicated the belief in many gods who were ever ready to avenge the slightest offense against their dignity. But mankind has a long memory, and the ancient fears still remained. The old deities were replaced by demons and witches. Evil spirits vied with each other in making life miserable in this vale of tears, and prayer had an active competitor in exorcism and magic. Charms were the most popular of all toothache remedies, sometimes spoken, but more often inscribed on paper, wood or stone and worn around the neck or loins. Those that referred to the Holy Trinity, the Virgin Mary, or some of the saints were considered the most potent. Never within recorded history has belief in supernatural cures been as prevalent as in Europe during the several centuries following the barbarian invasion.

Superstitious beliefs, however, were not limited to the mass of the population. Physicians and learned professors were no less credulous than the

laity. Late in the fourteenth century, John Gaddasen, an English doctor practicing in Oxford, advised the use of dried dung, reduced to a powder or the fat of a green frog to make teeth fall out by themselves and he added as proof positive of this remedy that "if by accident, while grazing an ox chewed up one of these animals, his teeth would fall out immediately." We may well wonder whether the doctor had ever put this method to the test or if he himself had seen this strange phenomenon happen to an ox. Dr. Gaddasen also recommended the brains of a hare not only to help dentition but also to make teeth grow again in place of those lost.

The workings of the medieval mind and the level to which dentistry had fallen is even more strikingly illustrated by the hoax of the "golden tooth." In the year 1593, in the town of Schiednitz, in Silesia, a golden molar was rumored to have erupted in the mouth of a seven year old boy. People came from far and near to admire the strange miracle. Among them was Dr. Jacob Horst, a physician and professor of medicine at Julius University at Helstadt. This doctor was greatly impressed and thenceforth devoted all of his energies to the study of the "golden tooth."

Dr. Horst wrote a book on the subject in which he maintained that the phenomenon was produced partly by natural and partly by supernatural forces, which were influenced by the constellation under which the child was born. "On the day of his birth, December 2, 1585, the sun was in conjunction with Saturn in the sign of Aries and in consequence of the circumstance, the nutritive forces were particularly powerful. An increase of heat resulted in the deposit of gold in place of tooth substance." After thus explaining the origin of the phenomenon, Dr. Horst examined what events were portended by the strange occurrence. In his opinion, there was no doubt that the "golden tooth," like eclipses and comets, must be a precursory sign of important events, and supporting this assertion by arguments of various kinds from the Bible and with the aid of astrology, the professor arrived at the following conclusions:

Since the tooth was on the left side of the lower jaw, great calamities would precede the epoch of happiness. On the other hand, as the golden molar was the last in the child's mouth, it signified that the epoch thus foretold would be the last of the ages in this world before the Day of Judgment. In greater detail the golden tooth indicated that war and pestilence would be followed by the sweeping out of the Turks from Europe, then would come the "Golden Age," and finally the Day of Judgment.

Considerable controversy followed the publication of the book. A few

people had the good sense to recognize the fraud, but the greater number of those who entered the discussion had not the slightest question as to the reality of the fact. They differed from Dr. Horst only in the explanation of what caused the miracle and the interpretation of its significance. One hundred years later another dissertation appeared on the subject of the "golden tooth," in spite of the fact that shortly after the publication of Dr. Horst's book, the chewing surface of the gold crown had worn down and exposed the natural tooth. The whole affair was, of course, nothing but a hoax perpetuated by a skillful goldsmith who had fitted a gold crown on the molar, hiding the margins below the gum line. A proper examination would readily have disclosed the deception, but that was the Age of Faith, and people preferred to believe rather than to investigate.

Another curious hoax practiced upon the people during the Middle Ages was the sale of narwhal tusks at fabulous prices as the genuine horns of the mythical unicorn, an animal famous in ancient lore. A picture of this creature appears on the Royal Coat of Arms of Great Britain. It has the head and body of a horse, hind legs of an antelope, tail of a lion, and one large straight horn in the center of its forehead. The stories told about the powers and behavior of this strange animal were no less fantastic than its structural anatomy. No living creature dared to engage it in combat. Even the elephant would flee at the stamping of its foot. Yet the unicorn became tame and tractable at the mere sound of a virgin's voice. Obviously, the horn of such a wonderful creature must have great magical powers. It was said, for example, that if the horn touched the water of a polluted pool while the animal was drinking, the water immediately would turn clear, fresh and sweet.

Throughout the Middle Ages, these "horns" were highly valued for their magical and healing powers. Kingly scepters were often made from them and Charles V once paid a large debt with one "horn." The Venetian Senate, composed of hard trading merchants offered $67,500 in gold for an usually fine specimen but the offer was refused. Based on the present day purchasing power of gold, such a sum is equivalent to about $300,000.

After the development of navigation, when European sailors began to venture into the far North Atlantic where this species of whale makes its home, the tusks became very common and the hoax was discovered. But superstitions have long lives and people continued to believe in the efficiency of the narwhal tusks as a remedy for certain ailments, and it is only recently that powdered unicorn disappeared from apothecary shops.

The barbers probably turned to blood-letting because of their skill in

handling sharp razors. The red and white poles in front of our "tonsorial parlors" is the ancient sign of the white bandage on a bleeding arm. Later having become habituated to the shedding of blood, the barbers quite naturally included tooth pulling as a branch of their art. Barbers extracted teeth not only in ancient Rome but also throughout Europe, and among the Arabians in the Middle Ages. Abulcasis speaks satirically of the "silly barbers" and criticizes them for their ignorance and the injuries which they caused to their patients. In the fourteenth century the famous surgeon Guy de Chauliac (1300-1368) seems to have thought rather well of the "dentators" as he calls them, although he suggests that they should operate under the supervision of a qualified physician.

The barbers were incorporated in England about 1460, and under a charter from Henry VIII. They united with the company of surgeons, barbers being limited to extraction of teeth and minor surgery, though general surgeons were not permitted shaving or barbering. In France, barber-surgeons were incorporated in the reign of Louis XIV.

Though both surgery and dentistry originated in the same humble calling, their paths finally diverged. The surgeon always more or less connected with medical practice was eventually incorporated with the main body, as physicians and surgeons. Dentistry however continued in the hands of the barbers until more recent times. Only since recognized universities began to train dental students and the educational level was raised have dentists become recognized as members of a learned profession.

During the Middle Ages the barber-surgeons had several competitors in the business of tooth extraction. Anyone who could wait until market day might have had his teeth removed by one of the itinerant tooth drawers. These vagabonds who set up shop at every street corner was a shifty lot with an unsavory reputation. They boasted as brazenly about their painless extraction as the advertisers of today and were responsible for the saying common throughout Europe, "He lies like a tooth-drawer." Still, some of these men developed considerable skill, and many people patronized them in preference to the barber-surgeons.

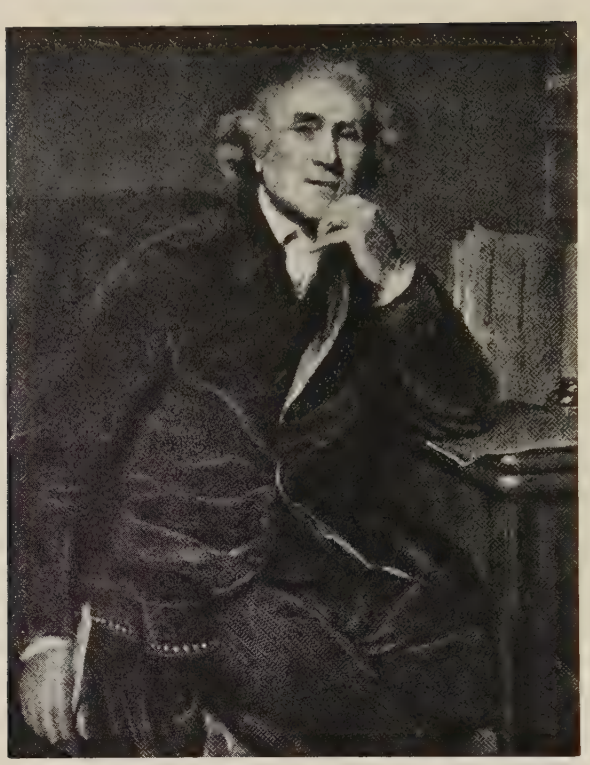
The keeper of the public bath house was also an amateur tooth puller and in case of emergency the state executioner if not otherwise engaged was not averse to gauging out a few molars. This rather popular official had ample opportunity for acquiring experience in extraction. It was part of his job to pull out teeth of culprits who ate meat during lent, or to force a confession from a suspected criminal. Occasionally, he was able to keep in practice by removing a molar a day from some reputedly rich Jew as a

means of forcing a large contribution to the king's treasury. Except for extractions, however, dentistry in Europe was almost non-existent for more than a thousand years.

The preferred position for extraction was to lay the patient prone on his back and his head held between the knees of the operator. Professor Plateario of Pisa (1450-1525) is credited with being the first to use the sitting position. (He was probably the first to put the suggestion into print.) At the beginning a common chair was used. Later arms and some kind of a head rest were added. Chairs that could be raised and lowered appeared about 1848. Fairly good mechanical chairs were not brought out until about 1871. The fountain and cuspidor belong to about the same time. The hydraulic chair was patented in 1851, but was not marketed until some thirty years later. The first motor raised chair appeared about 1922.

DR. PIERRE FAUCHARD

Pierre Fauchard (1678-1761) was a native of Brittany and his impression upon dentistry has been so far-reaching that he has become recognized as the "Father of Modern Dentistry." Fauchard's professional life extended over a period when charlatanry in dentistry flourished to the highest degree in all Europe, and one of the greatest services that he rendered to his profession was his efforts to suppress and counteract the nauseous activities of those quacks in an endeavor to establish dentistry as a scientific profession. His notable work, "Le Chirurgien-Dentiste," first published in Paris in 1728, became a classic in dentistry, and the scope of his knowledge of practically every phase of dentistry, as portrayed in this book, stands today as a marvel of accomplishment at such an early period. Fauchard became noted as the leading exponent of dentistry of his time and numbered among his patients many of the crowned heads of Europe. He was the originator of many methods of practice in dentistry, some of which stand today practically as he designed them. He was one of the first to use a metallic band with ligatures for the movement of teeth in correcting irregularities, and his method of the treatment of pyorrhea by surgical means has been but little improved upon up to this time; in fact, he became so noted in this respect that pyorrhea was, and still is, known as Fauchard's disease.



DR. JOHN HUNTER

John Hunter (1728-1793) was born in 1728 at Long Calderwood, a small estate situated about eight miles from Glasgow. Hunter's activities were directed toward medicine and surgery, largely through the influence of his older brother, William Hunter, who located in London and began the teaching of surgery and anatomy. The younger brother, John, soon attained a reputation in the field of anatomy and surgery which almost eclipsed that of his brother. He was a man of the most aggressive type, ambitious almost to a fault. His studies of anatomy were so thorough that they became practically the foundation of the science of anatomy and the practice of surgery.

Hunter's studies and writings cover every phase of anatomy and one of his masterpieces, "The Natural History of the Human Teeth," published in 1771, is the foundation of all anatomical texts on anatomy of the jaws and teeth up to the present time. He was the first to attempt a classification of the teeth, and his classification stands today practically as presented by him originally. His studies of tooth anatomy have seldom been equaled and practically never surpassed. Although not a dentist, Hunter's contributions to dental anatomy were such that they commanded the admiration of the entire anatomical world and impose a debt of gratitude upon the dental profession that can never be overpaid.

CHAPTER XI

THE SIXTEENTH AND SEVENTEENTH CENTURIES

One of the outstanding characteristics of the Middle Ages was the blind submission to authority in every phase of life, in religion, politics, morals, and science. The divine right of kings, the papal bulls, or the teachings of the ancients were all accepted without question. Medicine, too, had its pope, Galen, and his statements were accepted by physicians with as much deference as the encyclicals of the vicar of Christ by the faithful.

But this condition could not continue indefinitely. Toward the end of the fifteenth century, a spirit of rebellion against authority developed throughout Europe. This new attitude was the result of many factors, such as the discovery of America, the destruction of Constantinople by the Turks forcing many Greek men of letters to migrate into the west, and the introduction of printing in 1436 which made books cheap and easily accessible to everybody.

In 1520 Martin Luther defied the Pope, the greatest authority of the ages, and not long after Andreas Vassalius the famous Belgian anatomist infused new life into medical science by destroying faith in Galen. Unlike Luther, Vassalius was not an iconoclast. He was merely interested in human anatomy and wanted to see with his own eyes the structures which the great ancient doctor had described. But his path was not easy. The medical profession was steeped in ignorance. When he started to point out some of the errors in Galen's statements, the Parisian professors refused to believe him. They actually called him a mad-man and began to persecute him. Fortunately, the University of Padua in Italy, where his fame had already reached, asked him to occupy the chair of anatomy and Vassalius was glad to get away from the stifling atmosphere of Paris.

Padua was a part of the Venetian republic where no cleric was ever

allowed to hold a civil office, and the papal authority was powerless to interfere in the affairs of the great school. Anatomic dissections in Padua were therefore free and unhampered by fanatics or henchmen of the inquisition.

At the early age of twenty-eight Vassalius published his famous work wherein he corrected nearly two hundred mistakes in Galen's anatomy, which had always been accepted without question. Discrediting ancient authority, Vassalius freed the mind of the profession, and laid the foundation for true scientific research which is the basis of present day medical practice.

Beyond a fairly accurate anatomical description of the teeth and the pulp chambers, Vassalius's contribution to dentistry was comparatively insignificant, but he was the first to check Aristotle's statement that women had fewer teeth than men. His method was extremely simple. He counted the teeth of several individuals of both sexes. Aristotle was wrong, and another illusion of men's superiority over the weaker sex was removed. And yet fifty years later a professor at the University of Leyden stated that "rarely do women have thirty-two teeth like men." This is really not surprising; there are some people today who still insist that the world is flat. Vassalius also counted the human ribs and exploded another myth which was widely believed at the time; that man had one rib fewer than woman, because the Lord took one of them to make Mother Eve.

Vassalius' fame as a scientific investigator spread all over Europe and brought him an appointment as physician to the great court of Spain. But that benighted country was a poor place for a scientist. Dissection in Spain was prohibited under the penalty of death and so the great anatomist stopped his research and became nothing more than a flunky to the degenerated Hapsburgs.

One day Vassalius was performing an autopsy upon a Spanish nobleman who had died suddenly and while opening into the chest cavity some of the by-standers thought they saw the heart pulsating. Immediately he was accused of murder and sacrilege. The inquisition, ever ready to guard the honor of the dead, began gathering the faggots for his pyre. Only the intervention of the king saved his life and in order to hush up the matter he was advised to expiate his sin by a pilgrimage to the Holy Land.

What made Vassalius take up the scalpel again we do not know. Perhaps he had heard about the work of his brilliant pupil Fallopius, who had continued his investigation while his former teacher was in favor at the court. At any rate, upon his return from Palestine he readily accepted a

professorship which was offered him again by the University of Padua. Unfortunately, he was ship-wrecked on a small island while on his way to Italy and was found dead in a small hut. It is believed that he died from typhus and as one medical historian puts it, "the greatest physician since Galen was killed by a louse."

To Fallopius we are particularly indebted for a fine description of the trigeminal, auditory, and glosso-pharyngeal nerves. To him also we owe the terms "hard" and "soft" palates. Fallopius and Eustachius gave us a complete description of the anatomy and development of the teeth in every age of a person's growth, from early uterine life, until the final eruption of the permanent set. Eustachius also discovered the peridental membrane, which he describes as "very strong ligaments, principally attached to the roots by which these latter are tightly connected to the alveoli." In spite of his unusually keen observation Eustachius erred regarding the causes of tooth elongation for he repeated the old error that human teeth continue to grow throughout life.

The great anatomists of the sixteenth and seventeenth centuries, although they added considerably to dental knowledge, were not interested in oral diseases or their treatment. Credit for much valuable contribution in this field belongs to Ambrose Pare the great Parisian surgeon.

Ambrose Pare was born in 1517 of humble people. His father and one of his brothers were box-makers, another brother was a barber. Pare had very little education. As a young boy he probably hung around his brother's barber shop and there developed an interest in that trade. Later, he was apprenticed to a barber, where, besides learning haircutting and shaving, he also acquired a knowledge of bleeding and tooth pulling. At sixteen, he entered the employment of a barber-surgeon in Paris. Under his tutelage, he had the opportunity to practice in the city hospital and later in the sanitary division of the army. But his lack of education, and his ignorance of Latin impeded his progress. In spite of his extraordinary skill, it was not until he had reached the age of thirty-seven that he was allowed to take the required examination to become a member of the College of Surgeons in Paris. After that his progress was rapid and within a few months he was given the title of Doctor of Surgery. In 1562 he was appointed surgeon to the French court, a position he held during the reign of Charles IX and Henry III. Ambrose Pare was a Protestant and it is said that during the massacre of the Huguenots on St. Bartholomew night the king saved his life by hiding him in a wardrobe.

The great surgeon never forgot his early training and experience as an apprentice in the barber shop. He never lost interest in tooth extraction or in dental diseases. Pare did not practice restorative dentistry as we understand it today. He did not fill teeth or construct bridges. He was an oral surgeon; he extracted teeth, opened dental abscesses and set fractured jaws, not in the crude manner of his colleagues, but with skill and good judgment.

As an observer, Pare was rather less keen than either Fallopius or Eustachius, but he excelled them in the practical application of his knowledge. In his writings Pare describes minutely various operations in the mouth, including a method of transplanting teeth, and he also mentions briefly artificial substitutes made of bone which are held in place with gold or silver wires. However, he does not tell how such appliances were made. The illustrations of his instruments show considerable ingenuity and though crude according to our present standards could be used by any skillful dentist if he had no others at hand.

Pare was the first to describe obturators for cleft or perforated palates. Cleft palates are congenital openings in the roof of the mouth, caused by the failure of the two halves of the skull to unite at the mid-facial line in fetal life. This deformity occurs about once in every two thousand children born, and it is often associated with hare-lip. Palatal perforations are also occasionally the sequelae of untreated syphilis infection. These syphilitic perforations probably started Pare on his search for something that would relieve those unfortunates whose palatal bone had been destroyed by the disease which had become so common in his day. It is generally believed that syphilis swept over Europe soon after the discovery of America. Some claim that the sailors who accompanied Columbus to the new world brought the terrible affliction back with them. In many countries it was known as the French disease because Paris, entertaining visitors from all over the world, was undoubtedly responsible for scattering the infection. At the beginning when nothing much was known about the disease or its treatment, many people suffered the destruction of the roofs of their mouths. Pare's obturators for closing these openings enabled the poor sufferers to eat more comfortably and enunciate their words much better.

Modern knowledge of syphilis and the standardized methods of treatment have rendered the perforation of the palate unusually rare. Congenital cases are now operated on during infancy, and the cleft is obliterated. Rarely, now, is a dentist called upon to construct an obturator.

Another scientific investigator to science who helped the advancement of dentistry was Leeuwenhoek (1632-1723) the inventor of the microscope, who discovered the dental tubuli which he describes as being so fine "that six or seven hundred of them are no thicker than a hair from one's beard." He also examined tartar scrapings from the teeth and was the first to see the organisms that inhabit the human mouth.

Besides these there were a number of other men in France, England and Germany who, collectively, helped to further the progress of dentistry. However, none of their individual contributions was sufficiently important to be singled out for special mention. Even at that early date we find several monographs which deal exclusively with dental problems. The tendency to separate from surgeons on the one hand and barbers on the other was becoming quite noticeable.

Some writers still believed that "hot humors" were the main cause of dental abscesses. To expel these humors they applied leeches to the neck, cups behind the ears, plasters to the temples, hot vinegar, garlic juice into the ears and other similar remedies. The dental profession can be justly proud of having abolished these senseless treatments and saving the unlucky sufferers needless agony. Simple toothache was usually attributed to worms, some even thought that when they broke open an extracted tooth they could see the worm. Dental patients of today have frequently mistaken the pulp for a worm. To stop toothache a number of drugs was suggested; mostly bitter and nasty substances. The intention presumably was to make it so uncomfortable for the worm that it would hasten to leave its habitation; an echo of the methods used by the Ancients.

Scrapers for the removal of tartar were advised by several writers, one suggested that the teeth of princesses should be scraped only with gold instruments. Of course for the common people iron scrapers were good enough.

The filling of teeth with gold leaf, and the use of ox-bone and ivory for artificial restorations are often referred to by different authors, but never described in detail. Illustrations of extraction forceps and other operating instruments began to look as though they could perform the operations for which they were intended with some degree of efficiency.

The seventeenth century ends the first half of our story. It is quite evident that the dental knowledge which had accumulated up to that time was very limited indeed and we can readily agree with the eminent dental historian Dr. Guerini, who, commenting on a certain dental book published

in 1638, concludes that "if all previous publications had been lost this book would have been of inestimable value. For it contains all that had been written about dentistry." In short, all dental knowledge of real value from the time man suffered his first toothache until the arrival of Fauchard, could have been printed in a single volume.

CHAPTER XII

FAUCHARD AND THE BEGINNING OF MODERN DENTISTRY

No single individual in the history of dentistry exerted a more powerful influence on dental progress than Pierre Fauchard, the famous French dentist of the early eighteenth century. He was fortunate in that both time and circumstances were favorable for the development of his great abilities.

The two hundred years prior to Fauchard's arrival on the scene had been very fruitful. Although dental knowledge was still unorganized considerable progress had been made. About the year 1700, dentists were already recognized as a distinct group in the city of Paris, even to the extent of forming an examining board to test candidates desiring to enter dental practice. Fillings and artificial appliances of one kind or another were fairly common in the larger capitals of Europe and were probably better than any which had been done since the fall of Rome. Fauchard was undoubtedly familiar with the various operations of his contemporaries when he began practicing in Paris in about 1715.

The great city gave Fauchard unusual opportunities for the exercise of his ingenuity and enabled him to translate many of his theories into actual practice. The nobility of France, oblivious to the suffering of the masses, and stimulated by the extravagancies of the French court, were spending their money freely for all kinds of luxurious living and refinement. Incidentally the majority of intelligent Frenchmen ceased to be interested in the hereafter or in the fate of their souls after death. High society developed a pagan view of life. Beauty became the dominant note of the age. Well-to-do people sought health, comfort and good looks and tried above all to retain their youth. Since a toothless face can look neither young nor beautiful, there was great demand for dentistry, which gave Fauchard the opportunity to develop his art and talent.

Fauchard's early life is obscure. All we know is that in his youth he came under the influence of a chief surgeon of the French navy, who was reputed to have wide experience with diseases of the mouth. This information comes to us from the following reference in Fauchard's book.

"To him I owe the first rudiments of knowledge I have acquired in the surgical specialty which I practice, and the progress I have made under this able man gave me the emulation that has led me on to further and important discoveries."

Another man under whose influence Fauchard came later was Mons. Carmelin to whom he refers as an able and popular dentist.

In 1728 Fauchard's book entitled "Le Chirurgien Dentiste" was published in two volumes containing 863 pages and 40 full page illustrations. It was the most important book of its kind ever written and must have been a treasure trove of information for the dentists of his day. Every then-known phase of dental practice was treated comprehensively and in great detail. How to fill teeth with gold leaf tin foil or with lead. The latter was a popular filling in those days. The French still call a dental filling "plombage," regardless of its material. Plomb is the French word for lead.

Fauchard also told how pivot crowns, made from ivory or human teeth could be fastened to the natural roots. He illustrated a number of dentures both full and partial, and all types of ingenious devices to keep those appliances in place. He advocated methods for the straightening of teeth. Though these would not be acceptable today they were a step forward in that art. His forceps and elevators began to take on modern shape and many of his instruments can be recognized as the crude patterns of those in use today.

Fauchard, besides being an inventor and skillful mechanic, was also a scientist with keen powers of observation. Part of his book is devoted to the history of the development of the teeth, from fetal life, through the final eruption of the permanent set. He also discusses ailments during infancy due to teething, treatment of oral diseases, fractures and the relief of toothache. He laughed at the "worm" explanation of decay and suggested pulp-removal by inserting a red hot needle into the pulp canal; a crude and heroic method. And yet, no less crude than the "knock-out" method which was used a half century or more later. This was applied only to the front teeth and was done by placing a hard wood peg into the root canal on top of the pulp which was fully exposed and giving the peg a sharp blow with a small mallet. He could, of course, have used

arsenic for the purpose with more success and greater comfort to the patient, but the pulp-killing properties of that drug were not discovered until many years later. The drugs Fauchard depended upon for the relief of toothache were oil of cinnamon or oil of cloves and these can be found in every dental office today. But, it is rather curious that a dentist, with all his knowledge, should have recommended one's own urine for a mouth wash to preserve teeth. This error, however, does not detract in any way from his generally clear and accurate observations.

Fauchard's book went through three editions in French and was translated into German. For many years it remained the encyclopedia of dental information wherever dentistry was practiced, and stimulated and advanced the progress of the profession.

Fauchard's publication of his knowledge and the divulging of his methods and processes was a new departure in dentistry, for he was giving away the trade secrets of his group and interfering with the privileges of vested interests. His colleagues, who were often able to capitalize on the ills of their patients, objected to Fauchard's book strenuously. Times and conditions may change but the attitude toward a possible loss of profits never seems to vary.

However, Fauchard had clearer vision than most of his contemporaries. From his early training as a physician he had learned that the success of medicine was the result of the very practice which dentists had neglected and for which he was being criticized—dissemination of professional knowledge. It had been the age-old tradition of the medical profession that all knowledge of their art must be shared in common as a sacred trust for the service of suffering humanity. From time immemorial it has been against the code of medical ethics to capitalize on methods or processes, by withholding information or patenting inventions. Fauchard believed that if dentistry was ever going to become a branch of medicine and take its place with other medical specialties, it would have to adopt the same code and follow the same rules.

Fauchard expresses this thought clearly in the preface of his book in which he says:

"This experience which I have acquired during an uninterrupted practice of more than forty years—I offer to the public the result of my labors, and my studies, hoping that they may be of some use to those who wish to exercise the profession of surgeon-dentist."

Fauchard's unselfish attitude inspired other men to share their knowledge, through lectures, books, and essays in journals, with the humblest

members in the profession, and dentistry was changed from a trade wherein the profit motive was dominant, and technical secrets zealously guarded, into a profession that placed the patient's interest above private gain. To serve that interest scientific knowledge became accessible to every member of the organization. For this more than for anything else Fauchard deserved the title "Father of Dentistry."

In 1737 Fauchard made a set of teeth for a lady. They were held in place with springs and he relates that the lady ate with them easily and could not get along without them. He also tells about a full lower set which one of his patients wore for more than twenty-four years, and that in three instances his patients wore full upper plates without the aid of any spring at all.

Apparently Fauchard did not appreciate the fact that it was atmospheric pressure that kept dentures in position. He probably thought that the adhesiveness of the saliva was the main cause and since the viscosity of saliva varies with different individuals, and therefore cannot be depended upon always, he continued with the springs. About 1800, James Gardette, a French dentist who immigrated into this country, made a set of dentures for a patient, but not having time to adjust the springs, let him wear the teeth in the meanwhile. Three weeks later, when the patient returned, Gardette found that the plate stayed in and that springs were entirely unnecessary. Unlike Fauchard, Gardette immediately recognized the part which atmospheric pressure played in the retention of those dentures, and the use of springs was soon discontinued. Nevertheless as late as 1848 the United States patent office considered this process as original and novel, and granted a patent to a Connecticut confectioner on a "dental plate held in place by atmospheric pressure." Of course the patent was invalid.

Among the numerous contemporaries of Fauchard we may mention Moutone, a French dentist who wrote a monograph on mechanical dentistry, describing the construction of gold crowns. John Hunter, the celebrated English surgeon whose two books, "Natural History of Human Teeth," and "Practical Treatise on the Diseases of the Teeth," were quite epoch making. Hunter was keenly interested in replanting and transplanting of teeth. Judging from the space devoted to this subject by the different writers of that period, this operation must have been very profitable. There are records of fees running from two to six pounds, depending upon whether the tooth was alive or dead. Live teeth were naturally more expensive because their owners had to be reimbursed for the loss. English

papers often carried advertisements offering two or three pounds each for perfect centrals and laterals.

Under the date of August 1872 the following announcement appeared in one of the New York papers:

"Teeth—Any person who is willing to dispose of his front teeth may hear of a purchaser by applying to Number 28 Maiden Lane, for which a generous price will be given. N.B. Four guineas will be given for every tooth." These teeth were evidently used for transplanting.

Joseph Le Maire who practiced in Philadelphia about the time of the American Revolution advertised that he had transplanted 123 teeth in six months. We have no reason to question the number but are quite justified in doubting the success of these operations. The fact is that transplanted teeth were never very permanent. However, before the invention of porcelain teeth and the development of crown and bridge work it was a reasonably logical operation for repairing disfigurements in the front of the mouth. Transplantation was advocated in this country as late as 1890.

Philip Pfaff, dentist to Frederick the Great, also deserves special mention. He was an ingenious and skillful operator. Pfaff's outstanding contribution was the invention of plaster casts in the year 1758. These were made from wax impressions.

To the present-day dentist who is constantly making models of one kind or another this may seem like a simple contrivance, but to the man in the eighteenth century the solid hard models, to which ivory plates could be adapted was a great improvement. The common procedure was to place the ivory plate on the cast which had been coated with some coloring material previously and then remove the high spots as they appeared on the plate. This was repeated until a perfect adaptation to the model was obtained; a tedious and slow process, of course. But prior to that the models were made of wax, and carving was done with calipers or other measuring instruments. In either case the final fitting was usually done in the mouth by staining the tissues. That was how George Washington's false teeth were made. Plaster casts did not come into use in this country until about 1820.

Wax was a fairly satisfactory impression material. It is not surprising therefore that plaster was not adopted for this purpose until more than two decades later. Full mouth plaster impressions were first made in the United States in 1844.

CHAPTER XIII

PORCELAIN MORTARS AND MOLARS

Scientific information is now thoroughly organized and many inventions or discoveries are the result of purposeful research and experimentations. But in the eighteenth century there was little if any relation between the various branches of knowledge. Most inventions were the result of sheer accident.

A striking example in our field was the introduction of porcelain into dentistry which happened simply because a certain M. DeChateau, an apothecary of Paris was very much annoyed by the ivory teeth which he wore. There was good reason for his annoyance. The apothecaries of the eighteenth century were really drug dispensers, not vendors of ham sandwiches or double chocolate sundaes. It was one of their duties to prepare the concoctions which they used in the filling of prescriptions. Some of the concoctions required tasting to determine their potency, and it was that tasting which caused M. DeChateau all his trouble. The various chemicals tainted his teeth all the colors of the rainbow, red, green and blue predominating, and in spite of all the chemical knowledge at his command he was unable to bleach them back to their natural ivory color. Even a less sensitive man than M. DeChateau might have been disturbed.

Finally, in despair, M. DeChateau conceived the idea of having a set of teeth made of porcelain. Just how this thought occured to him we do not know. Perhaps it was while washing his mortars that the idea came to him. For these mortars in which he triturated the various chemicals never discolored since they were made of glazed porcelain, the glaze eliminating all possible absorption. Why could not teeth, too, be made from the same material? Then, like the mortars, they too would never discolor.

In 1774 DeChateau was able to induce a porcelain manufacturer familiar

with the ceramic art to undertake experiments in the making of teeth out of porcelain. But without exception all the early trials were unsuccessful. The porcelain paste had a tendency to shrink in the baking and the finished dentures after coming out of the kiln were invariably too small. To allow for the shrinkage they tried to make larger models but the results were not much better. The plate would not fit, stay in place or feel comfortable. When M. DeChateau was about ready to give up, he succeeded in enlisting the interest of M. DuBois De Chamant, a prominent dentist in Paris. Together they made fresh attempts, finally modifying the composition of the paste, so that it fused at a much lower temperature, thereby reducing the shrinkage. This enabled them to bake a set of teeth which fitted well enough, so that M. DeChateau could wear it with a fair degree of comfort. At last the sensitive apothecary had teeth of hard, smooth and shining porcelain, which, like his mortars were not discolored or tainted by drugs or chemicals, and which he could wash clean. The Royal Academy of Surgeons in Paris recognized M. DeChateau's contribution and awarding him honorable mention.

M. De Chamant, being a dentist, naturally appreciated the importance of the new discovery. The superiority of porcelain over porous ivory in the mouth was self-evident. It was easier to mold and bake porcelain paste than to carve teeth from ivory. After several years of effort, M. De Chamant made a number of satisfactory dental plates that fitted and looked well. In 1788, he published his first pamphlet on mineral teeth, and a year later he received a patent on his invention from Louis XVI.

During the French revolution De Chamant emigrated to England, and lived in London until 1817, where he practiced his profession and advertised his ability to make artificial teeth of "uncorruptible mineral paste." De Chamant's appliance was made in a single piece, both the gums and the teeth molded and baked in one operation. This method, though successful in his hands, proved to be unsatisfactory when used by men of lesser skill and before long porcelain plates were almost abandoned.

Finding it difficult to bake complete porcelain plates that were sufficiently accurate, several men turned their attention to the making of single teeth which could be fastened to a metal base by means of platinum pins embedded in the porcelain. The first really successful result was obtained by Fonzi, an Italian, who in 1808 made known a new tooth which he called "terro matallic." In each tooth was embedded a single platinum hook to be attached to a base. Fonzi also improved the color of the porcelain and made the teeth more translucent. But although experiments with porcelain

began in France about 1774, it was not until 1817 that the first porcelain teeth were imported into the United States. These were still very crude and so poor in form that they were commonly called "French beans."

In 1830 Samuel Stockton, a jeweler and importer of teeth, began to manufacture porcelain teeth in Philadelphia. One of his apprentices was Samuel S. White, a nephew, who, after working for his uncle since he was fourteen years old at six dollars a week, decided that he was entitled to an increase in salary. But his uncle refused the raise, and White went into business for himself. In 1844 S. S. White began to manufacture porcelain teeth on a large scale, and the carving of ivory in dental offices passed out of existence. Today, the dentist has at his command many types of teeth for different purposes, made to match every form and shade found in the human mouth. Millions of teeth are now used annually and mass production has reduced the price so that the best quality teeth are no more than a few cents apiece. The price of the teeth hardly enters into the computation of the dentists' fee.

The name of S. S. White will forever remain one that is outstanding in the progress of modern dental art. The firm which White founded is still doing business all over the world.

Claudius Ash, founder of the English firm still operating under the name, also contributed greatly toward perfecting the porcelain teeth. Ash started early in the nineteenth century as a silver-smith, but became interested in teeth when a London dentist asked him to reproduce a dental appliance. Ash did the work so skillfully that before long he was devoting most of his time to making artificial restorations for dentists in that great city. He thus became the first laboratory mechanic in the history of dentistry.

Ash's work consisted mostly in riveting human teeth to plates carved from ivory or hippopotamus tusks. It usually took him about six weeks to finish a single case. Human teeth were collected on battle fields or on cemeteries and were an ordinary article of commerce generally engaged in by grave diggers. Ash abhored handling dead men's teeth and at the first opportunity began to use the "French beans." His desire to produce better teeth stimulated his efforts to experiment with porcelain. He started manufacturing teeth for the profession in England about the same time as Stockton did in the United States. Today "Ash Teeth" are known all over the world for their excellence.

Before the advent of manufacturers into the field and the development of large scale production, many dentists in this country baked their own

teeth. Several of them also made teeth for other dentists. They had to select and grind materials and fuse the porcelain in charcoal furnaces with the aid of bellows. These teeth were usually made in sections of three or four, the price was about twelve dollars per set. Allowing for the purchasing power of money at that time, this would be equivalent to at least twenty-five dollars today.

A number of competitors followed the S. S. White Co. into the manufacturing of artificial teeth, each one having his own notion of tooth form and for many years the selection of a proper set of teeth was a bewildering job. Even though Black published his fine book on dental anatomy in 1895, the subject still remained chaotic for nearly two decades afterwards. Teachers and writers advocated tooth selection by the temperamental system, nervous, sanguine and bilious, an echo from the hoary humor theory which has befuddled the medical profession since the days of antiquity. The only value of this theory was that it recognized the existence of three basic types.

It was not until 1911, after several years of close observation, that J. Leon Williams described the three grand divisions of tooth form as they actually occur in the human mouth. The adaptation of Williams' classification by manufacturers established the selection of artificial teeth on a scientific foundation.

For many years porcelain teeth were made with deep interdigitating cusps and grooves reproducing the conditions as found in the natural teeth, and not until recently did it occur to the dental profession that a set of dentures is not a set of teeth but a chewing device which is easily dislodged. The deep cusps which in the firmly fixed natural teeth help mastication, only cause interference in artificial dentures, and lessen their efficiency. The recent evolutionary tendency has been for cuspids and molars to lose their cusps.

CHAPTER XIV

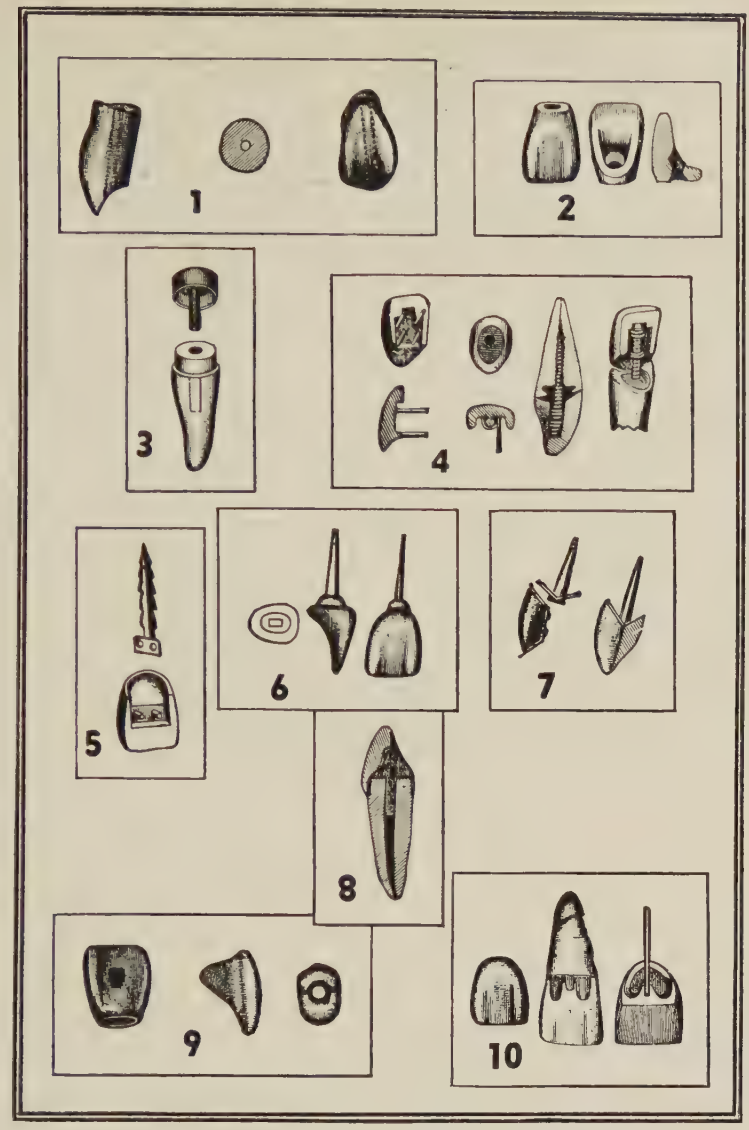
THE BEGINNINGS IN THIS COUNTRY

W. Dinley, a barber-surgeon or tooth drawer, brought over by the Plymouth colony about twenty years after the first landing of the Pilgrims, died shortly after his arrival in America. According to reports, he was lost in a snowstorm while on the way to Roxbury—now a part of Boston—to pull a tooth for a patient who suffered from toothache. This is the first reference to dental services on the North American continent. Probably there were a number of tooth-drawers in the different colonies as the population increased, but we have no record of them. Our first information about a regular tooth-extractor comes from the following announcement in the *New York Journal* of August 6, 1735:

"Teeth drawn and old broken stumps taken out very safely and with much ease by James Mills, who was instructed in that art by the late James Reading, deceased, so famed for drawing of teeth, he is to be spoke with at the shop of the deceased near the old Slip-Market."

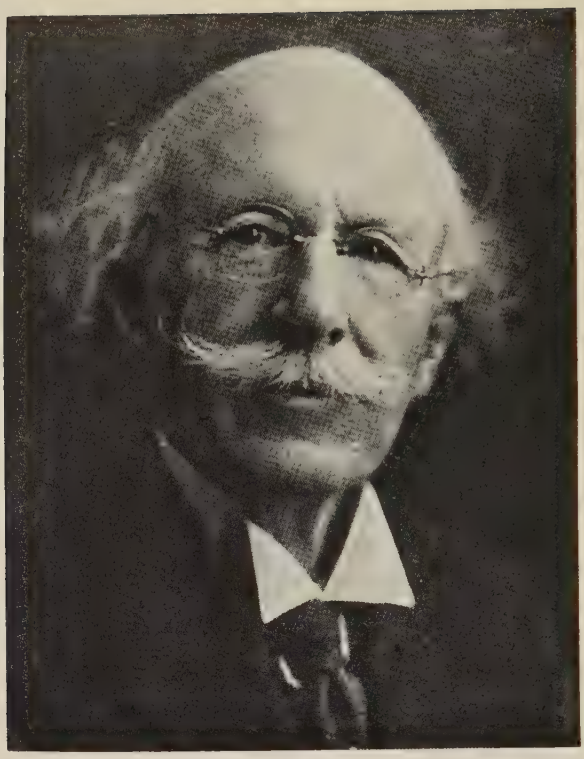
There is no reference to fillings or to any other type of dental services in the earlier years of the colonies. The American scene hardly encouraged the development of restorative dentistry. The necessity for clearing forests, fighting Indians and the general struggle to maintain themselves did not leave early settlers much time for luxuries. But shortly before the Revolution, when wealth and leisure had increased, the larger cities, like New York and Boston, became lucrative fields for the dental profession.

John Baker was probably one of the first competent dentists to practice in this country. He was an Englishman who arrived in New York City about 1768. His advertisement in the *New York Journal* in April of that year, gives us a fair idea of the services which he offered to the gentry of Manhattan:



VARIOUS TYPES OF PORCELAIN CROWN

1. English tube tooth, front and side view. 2. Foster crown, a threaded screw fitted depression on the lingual. 3. Buttner crown, preliminary of root to hold post in position. 4. How crown, the four pins were bent around the post. 5. Foster crown, the pins were engaged in the post and amalgam was packed in the depression. 6. Logan crown, front and side view. 7. Webb crown, gold backing fitted over pins and soldered to post. 8. Richmond crown.



DR. J. LEON WILLIAMS

J. Leon Williams, D.D.S., L.D.S., F.A.C.D. (1852-1932), was born in Maine, April 21, 1852. At the age of nineteen, Dr. Williams began the practice of dentistry under the tutorship of Dr. Roberts, of North Vassalboro, Maine. Soon after his entrance into practice his investigative mind asserted itself and he became interested in the microscopical study of the tooth tissues. His studies resulted in the presentation of new theories with regard to the histology and pathology of enamel, and precipitated considerable discussion because of their opposition to the views generally held at that time. However, the results of his researches in the histology of enamel stand today as they were climaxed in the series of articles which he published on the subject in 1907.

In 1887, Dr. Williams removed to London, England, where he built up a distinguished clientele, and there began his studies of the anatomy of the jaws and teeth which resulted in his classification of tooth form as a new conception of tooth anatomy in the field of prosthetic dentistry. He returned to the United States in 1912 and devoted practically his entire time to the perfection of his theory of typal forms of teeth. Dr. Williams was a constant contributor to the periodical literature, and the month before his death contributed a most interesting article on histology of the tooth structures.

"John Baker"
"Surgeon-Dentist"

"Begs leave to acquaint the gentry, that he is now in New York, at Mr. John Watson's, in the house wherein Captain Randall lately lived, at the corner of Pearl Street: . . . He cures the scurvy in the gums, be it ever so bad; first cleans and scales the teeth from that corrosive tartarous gritty substance, which hinders the gums from growing, infects the breath, and is one of the principal causes of the scurvy, and (if not timely prevented) eats away the gums; so that many people's teeth fall out fresh. He fills up with lead or gold, those that are hollow, (so as to render them useful) and prevent the air getting into them, which aggravates the pain. He makes artificial teeth and fixes them with pure gold, so that they will remain fast for many years, and may eat, drink and sleep with them in their mouths as natural ones, from which they cannot be discovered by the sharpest eye. He displaces teeth or stumps, after the best and easiest manner, be they ever so deep sunk in the socket of the gums. He has given sufficient proof of his superior judgment in this art, to the principal nobility, gentry, and others of Great Britain, France, Ireland, and other principal places in Europe; also to upwards of two thousand persons in the town of Boston."
"His dentifrice with proper directions for preserving the teeth and gums is to be had at his lodgings."
"N.B. Each pot is sealed with his coat of arms as in the margin of the direction, to prevent fraud."

In view of the state of the dental art in that period, Baker's claims were very much exaggerated. He was indulging in what our Federal Courts, in their decisions on misleading advertisements, have called "permissible puffing." The puffing must have paid. Records show that John Baker accumulated a sizable fortune out of his profession. Among other things he had a farm between what is now Park Avenue and the East River near 80th Street. He willed this farm to Trinity Church for school purposes. The present school on West 91st Street is endowed through the will of John Baker, Surgeon-Dentist.

Another Englishman, contemporary with Baker was Robert Woffendale who came to this country in 1766. He was a very skillful operator who was

reputed to have made the first set of upper and lower artificial teeth constructed in the United States.

The City of Boston also boasted a good dentist at the beginning of the Revolution. He was none other than our famous revolutionary hero, Paul Revere, who was said to have been a pupil of John Baker. The following advertisement was printed in the *Boston Gazette* of August 29, 1768:

> "Whereas many persons are so unfortunate as to lose their fore-teeth by accident or by other ways to their great detriment not only in looks, but speaking both in public and in private. This is to inform all such, that they may have them replaced by false ones that look as well as the natural and answer the end of speaking. To all interested, by Paul Revere, goldsmith, near the head of Doctor Clark's Wharf, Boston."

Another dentist of note during those days was John Greenwood, who advertised himself as "Dentist to his Excellency, George Washington, the President of the United States of America." Greenwood constructed the full upper and lower sets of false teeth that were worn by our first president during the latter part of his life. It is these false teeth that account for that strained expression about the lower part of Washington's face in nearly all of the pictures which have been printed on our currency and on our postage stamps. These pictures were copied from the Gilbert Stuart portrait, done when Washington was about sixty-five years old. Quite plainly it shows the lack of proper facial dimensions due to the shortening of the distance between the nose and the point of the chin. It also indicates absence of the normal inward curve in the contour of the lower lip, a condition which follows the loss of the lower incisors.

Stuart tried to compensate for Washington's facial deformity by padding small rolls of cotton under his lips. But the result was a benign, grandmotherly face better fitted to the yarns spun by Rev. Weems than to the man he really was. A much better picture replica is the one that appears on the 1932 twenty-five cent piece, copied from a bust made from life when Washington was fifty-three. At that time, he had some of his own teeth left. The relation between the upper and lower jaw was more nearly normal and the contour of the lower lip more natural. This bust is considered today a more accurate representation of the real Washington—the fighter and man of action who could swear or take a drink when occasion required. Incidentally, Washington's drinking habits and his love of good port probably were responsible for the discoloration of his

ivory teeth. At least, so his dentist Greenwood thought, for, on December 28, 1798, he wrote as follows to Washington:

> "Sir: I send you enclosed two setts of teeth one fixed on the old Barrs in part, and the sett you sent from Philadelphia which when I received was very black: occasioned either by your soaking them in port wine or by your drinking it. Port wine being sower takes off all polish and all acids have a tendency to soften every kind of tooth and bone. Acid is used in couloring every kind of ivory, therefore it is very pernicious to the teeth. I advise you to either take them out after dinner and put them in clean water and put in another sett or clean them with a brush and some chalk scraped fine. I subscribe myself, your very humble servant
>
> John Greenwood"

While it is possible, of course, that the black discoloration of the teeth may have been "occasioned by soaking the teeth in port wine," it is more than probable that the soaking was done while the teeth were in the mouth and that Greenwood was merely trying to be tactful.

John Greenwood's father, Isaac Greenwood, is believed to have been the first native born American dentist, though some believe that the honor belongs to Josiah Flagg. Gardette and Flagg, the two most able pioneers of the dental profession, were both trained in the art of dentistry by Le Maire when they were with a part of the revolutionary army in its winter quarters near Providence, Rhode Island. Le Maire was a surgeon of considerable ability and had studied dentistry with some of the best men in Paris. He was undoubtedly the most capable dentist to reach these shores.

As the country filled up after the Revolution, the number of dentists increased. By 1840, nearly every community of any size along the Atlantic coast could boast of one or more dentists. In the newly-opened Western States, cities like Cincinnati (whose population in 1825 was twelve thousand) had several dentists. Chillicothe, Ohio, in 1828, counted two dentists among its twenty-six hundred inhabitants. Even Bainbridge, twenty miles distant, which in the same year is recorded to have had "twenty-five dwellings, three stores, a forge, some mills and a total population of 279," had its dentist. Of course small towns of this size could hardly provide sufficient patronage to keep a dentist busy. In order to earn a livelihood most of these practitioners were obliged to travel through the countryside and from town to town like the Methodist Circuit Riders,

saving teeth of course, instead of souls. One of those itinerant dentists left us the following announcement:

"Dr. John Harris
Surgeon-Dentist

Respectfully tenders his services to the Ladies and Gentlemen of Chillicothe and its vicinity in the various branches of Dental Art. From his knowledge of the Medical profession Surgery, and Dental Surgery, in particular, he flatters himself that he shall be able to render general satisfaction to all who may be pleased to favor him with a call. He will set artificial teeth with much permanency and so natural in appearance as to escape detection and without that pain so consequent upon the operation as performed by most dentists, cure all cases of scurvy of the teeth, preserve those that are decaying, by plugging, extract all kinds of teeth and stumps with ease and perform every other operation of a Dental Character. His office is at his residence on Second Street. Dr. Harris pledges himself that all operations shall be performed in a style of neatness, elegance, and durability, not to be surpassed in the United States. His charges will be moderate."

Here is a list of Dr. Harris' fees:

For inserting Artificial teeth, each,	$3.00
" extracting " "	.50
" cleaning the teeth in ordinary cases	1.00
" treatment in relation to scurvy	From $3.50 to $5.00
" plugging teeth, each plug	1.00

Considering the high purchasing power of money at that time, these fees are better than the average charges of today.

John Harris was preceptor to Chapin B. Harris and James Taylor, the founders of the Baltimore Dental School and the Ohio Dental College at Cincinnati, the two institutions that had so great an influence on the progress of dentistry. It was this fact which prompted several Ohio dentists to call Bainbridge the "Cradle of Dentistry," and one can hardly quarrel with local pride.

A fair idea of the general status of dentistry at that time may be gained from some of the books published by the surgeon-dentist for popular consumption. These books were a form of lay education with the avowed purpose of advertising the writers' knowledge and ability.

The books first made their appearance in France after the middle of the eighteenth century and were soon copied in all other countries of central Europe and in England. The titles usually read, "The Care of the Teeth" or "Dental Art" and gave a simple description of the teeth, dentition, how to stop toothache and how to prevent scurvy. A dentifrice prepared by the author was generally recommended. Besides such general information the writer praised his own ability and skill without much reticence, and decried the methods of the "charlatans"—most of his competitors. The last chapters were generally devoted to the description of successfully treated cases and occasionally a few testimonials from satisfied patients of prominence were added.

Conditions in the United States may be judged from such a book which was published in London about 1773 by Robert Woffendale who later emigrated into this country and started practice in New York City in 1776. Of course some progress had been made by the time John Harris was instructing his two famous pupils, early in the nineteenth century, but such progress was comparatively slight. Dentists, like physicians, were still talking of "humors," "black bile" and "vital spirits." Teeth were supposed to consist of bone covered with enamel. The bone had a circulation connected with the "bulb" or "marrow" within the tooth. Toothache was often treated by luxation which consisted of tearing the tooth away from the pulp by means of a pair of forceps. Fillings were mostly tin or lead and were called plugs or stoppings. Our present word "fillings" did not come into use until about 1830. Artificial appliances were held in place by means of springs, which consisted of gold or silver swedged plates to which human or ivory teeth were riveted. Implantation and transplantation were popular operations. Occasionally anterior crowns made from human teeth or ivory were fixed into the roots with wood or metal dowels. Dental engines were, of course, unknown. The crown of the natural tooth was either clipped off with a pair of sharp forceps or sawed off at the gum line with a hand saw. That must have been a slow and tedious process.

Dental schools were non-existent either on the North American continent or in Europe. Dentistry could be learned only by serving an apprenticeship with a dentist for a number of years. There were neither diplomas nor state regulations. Anybody who so desired could set himself up in practice with no more restriction than the opening of a blacksmith shop. In fact, during early colonial days the blacksmith often used his tongs as forceps for tooth extraction. The only assurance of competence

that a dentist could give his patient was references from those whom he had served and occasionally a dentist would print testimonials in local newspapers just as patent medicine vendors do now.

CHAPTER XV

"PIVOT" CROWNS AND FACINGS

The earliest known reference to individual porcelain crowns is in a monograph printed by De Chamant about 1816. The crude drawing accompanying the brief description of a "single pivot tooth" indicates a restoration very much like our present day detachable post crown; that is, a porcelain tooth with a separate post. It is doubtful however that De Chamant had ever restored individual teeth in this manner, since there is no record that he had made anything else but complete porcelain dentures, base and teeth in one piece. In all probability De Chamant was not describing an actual operation, but was merely suggesting the possibilities of his "mineral paste."

Single tooth porcelain restorations were first introduced about 1840, after the English tube tooth was placed on the market. These teeth were intended to be riveted on ivory or metal plates, for full denture construction. But the hole through the center made them readily adaptable for attachment to natural roots by means of a pivot sunk in the canal. Such pivots were usually made of hickory wood, fitting tightly in the root and in the tube of the artificial tooth. They were first described in detail by Pierre Fauchard about 1728 in connection with the use of human teeth or ivory carvings. The worst of the many disadvantages of hickory pivots was that the moisture in the mouth caused the wood to expand and either the root or the porcelain crown would fracture. The substitution of gold dowels eliminated this difficulty, but there was no cement available to hold the posts firmly in position.

For several decades following 1840, dentists everywhere tried various methods for fastening porcelain teeth to natural roots, so that individual

anterior tooth restorations might be practical, but without much success. The earliest of these attempts, which was patented by Dr. Dodge in 1844, was followed by several others of similar type. The Foster crown, patented in 1855, embodied most of the previous improvements. This crown had a base almost flat, with a perforation in the body of the porcelain. The porcelain was so shaped as to form a seat for the accommodation of the enlarged head of a "screw pivot," by which means it was anchored into the root. Usually a small soft wood peg was inserted into the canal to hold the "screw pivot" firm. But the Foster crown was unsatisfactory; the soft wood usually disintegrated in the root canal, and the post became loose. Often the porcelain would split while the dentist was tightening the screw.

To overcome these troubles, some dentists used amalgam to keep the artificial tooth in position. Typical of these was a patented crown by Dr. Henry Weston in which the dowel was first fixed securely in the canal, and the crown then held in contact with the root and attached by packing amalgam around the projecting part of the post into a dovetail cavity provided within the porcelain.

Study of the numerous inventions in this field during those years made it clear that the problems of single tooth restorations was not so much the retention of the pivot within the root. Dentists could manage that somehow, either by use of a screw, or by wrapping the dowel with some cotton fibers soaked in resin. Their main difficulty was fixation of the porcelain substitute on the short end of the pivot projecting above the root and it was toward the solution of this problem that most of their effort was directed.

Among the several suggestions for accomplishing this purpose, the most successful was the one that substituted a pin facing for the porcelain crown, holding the facing in place by soldering the pins to the post or "pivot." Eventually the soldered facing, besides producing a satisfactory single tooth restoration, also laid the foundation for all the various appliances, classed as fixed bridge work.

First mentioned by Dr. Dwinelle in 1856, this method received rather scant attention, and almost fifteen years later a writer in one of the well known dental publications criticized the profession for not using "pivot teeth." The best detailed description of a procedure for the construction of anterior replacements of this type was given by Dr. James B. Bean in 1869. Part of Bean's technique included the insertion of a gold tube into the canal. This tube was closed at the apical end to prevent the seeping of moisture, and was held in place with malleted cohesive gold at the circumference.

The post to which a facing of proper shade and size had been soldered, was fastened into the tube with cotton fibers and resin.

But Bean's crown was a poor contrivance, for it left the root end exposed (excepting that part which came in contact with the facing). This formed a shelf for food debris and invited future decay, if the crown remained in position long enough (which was probably not often).

The next real improvement in this field was the invention of the Richmond Crown, patented in 1880. The main feature of this crown was a coping which banded and covered the root end. The coping, besides adding to the retention, also retarded the disintegration of the adhesive material with which the crown was set, by preventing moisture from seeping in alongside of the post. The coping also made it possible to duplicate the lingual contour of the natural tooth.

Although a very useful and serviceable restoration, the Richmond Crown was far too complicated in construction for single tooth replacement. Therefore, when the simpler Logan crown was introduced in 1885 its advantages were immediately recognized, and its general acceptance by the dental profession was almost instantaneous. In the Logan crown, the porcelain tooth was fused to a platinum post. Thus the problem of retention above the root was completely solved.

It is rather puzzling that during the years when the dental profession was struggling with the difficulties of single tooth restoration, the fusing of porcelain to platinum pins was the common practice in the manufacturing of teeth for dentures, and yet nearly half a century elapsed before the same principle was applied to the making of individual crowns.

Older dentists will remember gratefully the Logan crowns with their flat grooved posts which served as an ideal substitute for the centrals and cuspids until they were finally replaced by the less expensive, and more easily adjustable, detached post crowns. This crown, which is in universal use today, differs but little from the tube tooth of 1840. Indeed, with proper grinding, tube teeth may be made into acceptable anterior substitutes. The only difference is in the cement. The difficulties of early dentists were due almost entirely to the lack of a good adhesive. Even today most dental restorations would be impossible without the oxyphosphates of zinc.

The facings used by Bean, Richmond and others were ordinary denture teeth which carried platinum pins. Later, manufacturers provided special facings for this type of work. The addition of an extra facing to a Richmond, or gold crown, supplying a missing tooth, required no particular originality. Bridgework just developed as a matter of course; slowly at

first, but more rapidly after the invention of the dental engine in the seventies when the assembling of porcelain facings into various types of dental appliances became the chief interest of the profession and quickly surpassed any previous achievement in this field.

But the serious disadvantage of pin facings was the difficulty of replacement in case of breakage in the mouth. Such accidents were comparatively common. Although various bolts, nuts and whatnots were invented for making repairs, the broken facing remained the most annoying problem of fixed bridgework until after the turn of the century.

This annoyance was almost entirely eliminated by Steele's interchangeable facing which was introduced about 1904. The idea of detachable facings was probably originated by Dr. Walter L. Mason of Redbank, New Jersey, who had been allowed a patent in 1890 on a replaceable facing which contemplated a longitudinal bar baked into the porcelain at the median line and a backing with a slot for the accommodation of the bar.

But Mason encountered numerous and apparently insurmountable manufacturing difficulties. Often the bars did not fit the slots, and the interchangeability could not always be depended upon. Mason's facings therefore never became popular. After struggling for several years, he ran short of capital and was finally obliged to suspend operations.

Thomas Steele, who had been associated with Mason and was familiar with the problems involved, reversed the Mason method of attachment, placing the mortise in the facing and the tenon on the backing. This was an old idea originally developed by an Englishman, James Thom, who was granted a patent in 1857 on a detachable tooth for vulcanite dentures which was similar in principle to that developed by Steele. Thom's invention passed into oblivion for it was easier to make a vulcanite repair than to use detachable teeth. Besides the art of controlling the changes in porcelain during the baking process so that interchangeability became feasible, was not perfected until many years later. Thom was too far ahead of his time.

Nevertheless, these anticipations do not detract from Steele's accomplishments, for besides adding several new and valuable features which helped to make his facings practical, he was probably the first to produce a backing and facing that were absolutely and always interchangeable. Despite alterations and improvements which have been made in shades and molds, the attachment parts have never varied. A porcelain veneer made today will readily fit any backing manufactured in 1904, when Steele first started production. This, perhaps more than any other factor, explains the wide acceptance of Steele's facings wherever dentistry is practiced.

Success naturally invited competition. Several manufacturers have attempted to enter the field, but since most of them could offer no genuine improvements, distributors were not inclined to encourage duplication and the monopoly which Steele has enjoyed remains undisturbed.

Like DeChateau, Steele was a layman. His chief motive was profit. Nevertheless, he deserves to be included among the illustrious group who have helped to further the progress of dentistry. Fixed and removable dental appliances could never have attained their present excellence without accurately interchangeable facings, as improved and perfected by Thomas Steele.

CHAPTER XVI

HAYDEN AND HARRIS

Nothing is so completely American as restorative dentistry. The automobile or the typewriter may owe their development to the ingenuity of our people, but not to the same extent as dentistry. White's perfection of porcelain teeth was merely the beginning of a series of inventions and improvements which have brought dentistry to its present high level. Gas anesthesia for painless extraction, vulcanite rubber plates which made false teeth available to the poor as well as the rich, the cast gold inlay filling with its possibilities for tooth saving, as well as many other inventions either originated or were perfected in this country.

Everywhere, American dentistry is synonymous with the best. In every large European city, American dentists have enjoyed the most distinguished patronage, including the nobility and crowned heads of various European courts. Willoughby D. Miller was dentist to the Empress of Germany. Jenkins included in his clientele the King of Saxony and many other aristocrats of high rank. Dr. Thomas Evans served the court of Napoleon III, and was a friend of the Empress Eugenie. It was he who saved her from the Parisian mob and helped her escape during the revolution of 1871.

"Yankee ingenuity" may be a glib explanation for American excellence in this field. But over-simplification is always unsafe. Too obvious reasons are seldom correct. Racial aptitudes are not scientifically acceptable. Besides, with the exception of a few Indians, the American people came from various European stock. It would certainly be far fetched to assume that the mere crossing of the North Atlantic increased the ingenuity of an Englishman or a Swede.

The real reasons are far deeper. To begin with, the general prosperity

and wide distribution of purchasing power in the United States created a market for dental services far greater than could possibly have existed anywhere in Europe where the per capita income was much lower. This demand stimulated the inventiveness of the profession and dentistry improved just as it did in the early eighteenth century Paris or in the Rome of the Caesars. In addition to the economic factor, certain inventors, like Goodyear, Wells and others happened to be Americans. This of course was sheer accident, but the influence which those men exerted was an extremely important factor in the development of dentistry in this country.

But while those factors may well account for some haphazard progress, they hardly explain the rapid advancement which has been going on for nearly a hundred years; since about 1839, to be exact.

In that momentous year, three far reaching events occurred which altered the status of dentistry, first in this country, and later all over the world. Those events were—the establishment of a dental journal, the organization of a society, and the application for a charter to open a school for the training of dentists. These have rightly been called the "tripod" upon which the profession was built.

While 1839 marks the beginning of the great epoch in dental history, we know that great events do not just happen. Social progress usually follows years of preparation, originating in stimuli from many sources. Though it is impossible at this date to trace all the factors which finally culminated in the Baltimore experiment, we may point to at least one incident that must have exerted a powerful influence in shaping the thoughts of the dental profession during the previous decade.

In 1829 Dr. Solomon Sheldon Fitch of the city of New York published his book entitled, "A System of Dental Surgery," the most scholarly work that had appeared in any language up to that time. This book rapidly became the guide of the more intelligent surgeon dentists in the United States.

It is not stretching our imagination too far to assume that Fitch's contribution to dental literature may have been responsible in large measure for directing the attention of the more forward looking dentists all over the country to the advisability for a change in the methods of training dental students. Men of wider vision became convinced that dentistry could no longer be practised properly without some knowledge of anatomy, pathology, physiology and related sciences. They felt that the old apprenticeship method was no longer adequate since no one man was sufficiently

competent to teach all scientific subjects, and at the same time instruct students in the mechanical requirements of dental practice.

We know of no particular reason why Baltimore should have become the cradle of dentistry. There were several other cities in this country in 1839 where the profession was further advanced, perhaps, than in Baltimore. Probably the accident of leadership gave Baltimore its opportunity. It just happened that Hayden and Harris made their homes in that city.

Both men had studied medicine as well as dentistry, and had lectured in medical schools. So, in addition to their appreciation of dental problems, they also possessed the necessary qualifications for arranging a proper dental curriculum and efficient methods of teaching. There was also the fortuitous circumstance of a considerable difference in age. Hayden was 71; Harris was approaching 40. Wisdom, sagacity and energy were thus joined in launching the most important undertaking in the history of dentistry. Indeed, it is doubtful whether any combination of two men better fitted for the task could have been found.

It has been asserted often that it was not the intention of those pioneers to separate dentistry from medicine, but that the separation was due entirely to the attitude of the men in control of the Maryland University Medical School. The story commonly repeated was that Hayden and Harris had appeared before the regents, asking them to give special training in the necessary sciences to prospective students of dentistry, but that their request was refused because of the low esteem in which dentistry was held by physicians at that time.

Just where this had originated is hard to trace. Apparently those who have written on the subject never bothered to verify the correctness of the story. Actually there is no foundation to it. Perhaps no better evidence is necessary than the following quotation which appeared in the October issue of the Maryland Medical and Surgical Journal: (1839)

"'The American Journal of Dental Science.' The above is the title of a new periodical devoted particularly to the interest of our Brethren of the File and Forceps. It has reached its third number; one which has not in the least disappointed the high expectations created by its predecessors. We look upon this undertaking as fraught with interest, and pregnant with good to the community at large, and more particularly to the members of the profession.

"We commend it to the favorable attention of the medical community, and ask for it an extended patronage. We do this the more cheerfully because of the intimate connexion which exists in reality between this branch of our profession and those to the interests of which we are more immediately devoted. . . .

"We would particularly call their attention to an immediate effort either to establish schools of dental surgery in this country, or attach chairs devoted to this branch of a medical education, to the different colleges already in existence. Although many difficulties would necessarily be encountered in carrying into successful operation either of these suggestions we nevertheless believe that one or the other of them could be fully carried out, to the great benefit of both professions, and the people generally."

Furthermore at Harris' introductory lecture at the opening of the dental college, he expressed his gratitude "For the friendly feeling that has been manifested towards it by most of the medical faculty of this city." There is also the additional fact that in 1840 the University of Maryland had conferred the honorary degree of M.D. on Horace H. Hayden. In short we have no evidence whatever which would reflect unfavorably upon the regents of the University or on their attitude towards dentistry. The fact is that the need for dental training had been germinating within the profession for a number of years and the separation occurred because Hayden and Harris believed that a separate school would serve dentistry better. The results seem to have justified their belief.

The Baltimore College of Dentistry, the first dental school in the world, opened its doors on February 1, 1840. There was no fanfare of trumpets, no grand orations or laying of cornerstones. The faculty consisted of four teachers, Dr. Hayden, Dr. Harris and two physicians. The course of instruction in the various sciences was limited to sixteen weeks for students having already served an apprenticeship with a preceptor; and only two diplomas were granted the first year. Many of their friends had considerable misgivings about the success of the venture. Others believed that it was a mistake to start a special school and to separate the two professions. They urged waiting and patience, until some arrangement could be made with the medical fraternity, but Hayden and Harris did not share these opinions.

We must admire the courage of those pioneers, who with inadequate financial resources and very little outside support, embarked upon a new and untried project. Even the most sanguine optimist would not have believed that this puny and insignificant beginning would, within a comparatively short time, become the guide for dental education wherever dentistry might be taught. Certainly, the small faculty bidding goodbye to its first two graduates could hardly have foreseen that some day the yearly enrollment in dental schools would run into the thousands and that nearly all the 65,000 dentists practicing in this country today would be graduates from dental colleges that are part of our universities with the same standing as medical schools.

Five years later (in 1845) the Ohio Dental College was established in Cincinnati. These two schools, one in the East and the other in the West, gave wide publicity to the advantages of school training over the preceptor method and the demand for such schools increased rapidly. By the end of the Civil War there were several throughout the country. Among these, the dental school at St. Louis, Mo., later to become Washington University Dental School is entitled to special mention for the significant influence its alumni have exerted on every phase of dental progress. G. V. Black, whose name is familiar wherever dentistry is practiced, was a graduate of that school. Others of somewhat lesser reputation were Thomas Gilmer, a great oral surgeon and teacher of dentistry who was proud to be a member of the dental profession and who never missed an opportunity to impress upon his students their obligations as conservators of their patients' health, and Dr. C. R. E. Koch, author of the "History of Dentistry." Many others of equal caliber were also graduates of this school. Altogether 105 dental schools have been organized since 1840. The largest number in existence at any one time was in 1900, when there were 57. Of these, about 40 remain. They are now departments of universities.

The American Journal of Dental Science and the American Society of Dental Surgery antedated the opening of the first school. The first issue of the Journal appeared in June 1839 and in August of the following year, 1840, Hayden tapped the gavel at the initial meeting of the American Society of Dental Surgeons. These ventures however were short lived. A few years after the organizations of the dental society an acrimonious controversy regarding the use of amalgam developed. This was known as the "Amalgam War," and will be treated at some length in a later chapter. Most of the leaders took an arbitrary stand against the material, which the rank and file resented. The membership began to dwindle and although the society continued to exist for a time, it had lost its influence and finally died in 1856.

The Journal stopped publication four years later (1860), upon the death of Chapin B. Harris who had been its editor and guiding genius since its inception. But these efforts were not in vain, for they served as examples and stimulus to others. In the two decades following 1839, eleven dental publications were started in different parts of the country and they continued to increase rapidly. Today the total number runs into the hundreds.

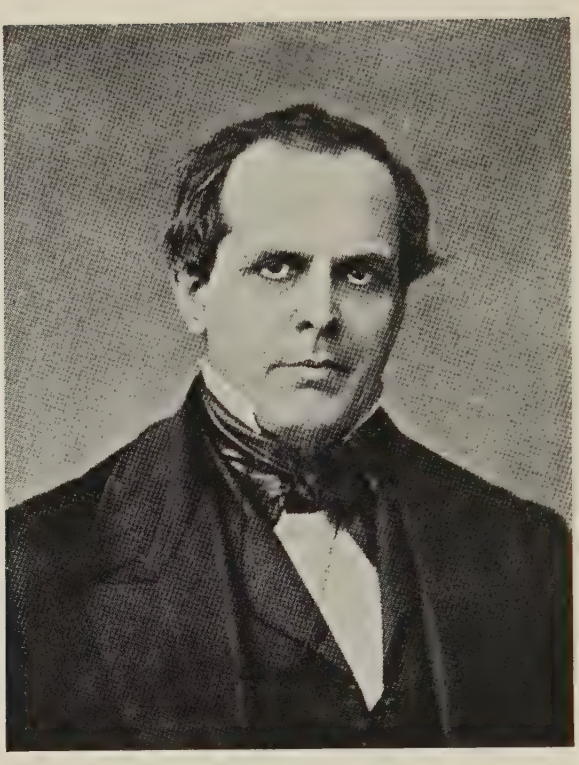
Most of the publications had an ephemeral existence varying from one to several issues though a few have done excellent service over a long

DR. HORACE H. HAYDEN

Horace H. Hayden, M.D., D.D.S. (1769-1844), was born October 13, 1769, at Windsor, Connecticut. Dr. Hayden procured his training in dentistry in the manner of the time, which was through study of such books as were available, medical and dental. After he felt himself prepared for dentistry he removed to Baltimore, Maryland, obtaining a license to practice dentistry in 1810. His eagerness to attain the highest qualifications for whatever he undertook brought to him a realization of the desirability of a knowledge of medicine as an adjunct to his dental profession. Accordingly he devoted himself to a mastery of the medical science and applied his energies to conform his practice toward improving his skill and abilities in the science and art of dentistry.

As early as 1825, and probably earlier, Hayden's abilities as a dentist were recognized through an invitation to deliver a course of lectures in dental surgery to the medical class of the University of Maryland, an honor never before bestowed on a practitioner of dentistry in the United States. In recognition of his ability as a practitioner and through his association with medical practitioners and lectureship, the honorary degree of Doctor of Medicine was conferred upon him by the Jefferson College of Medicine of Philadelphia and also by the University of Maryland.

In 1840, in association with Chapin A. Harris, he endeavored to inaugurate the teaching of dentistry in relation to medicine but his proposition was rejected by the University of Maryland, and he and Harris organized the first school devoted specifically to the education of dentists. It was largely through his efforts as a pioneer in dental education that dentistry soon became recognized as a separate and distinct specialty of the healing art.



DR. CHAPIN A. HARRIS

Chapin A. Harris, M.D., D.D.S. (1806-1860), was born in Pompey, Onondaga County, New York, May 6, 1806. In the history of dental journalism as well as in dental literature generally, the name of Chapin A. Harris stands out conspicuously as a pioneer. While Hayden may rightfully be credited with the conception of dentistry as a profession, it remained for the indomitable courage and energy of his co-worker, Harris, to bring about the realization of Hayden's dreams, and it is largely due to the labors of Harris that dentistry so quickly attained the full measure of a profession, through his efforts in the pedagogical field as a professor in the first dental school founded, as well as in the literary field through his editorship of the first dental journal.

As the editor of the *American Journal of Dental Science,* Chapin A. Harris realized the full scope of his literary ability and to this added two of the first textbooks published on dental subjects. He contributed regularly to the text pages of the journal he edited, but his efforts as editor were more instrumental in spreading the cause of dentistry and eventually resulted in its development as a separate profession. His courage and determination in the promotion of dentistry, reenforced by a remarkable mental and physical energy, made an impression both in the dental and medical profession that left a heritage to future generations. By precept and by example Chapin A. Harris probably did more to influence the direct dental development than any other man of his time or since.

period of years in disseminating information and guiding the thoughts of the dental profession.

It was the common history of many dental journals that they first started under the auspices of some society or group of dentists, as an expression of professional opinion, and later fell under the sway of supply dealers. This was not because of a Machiavellian plot on the part of supply houses to control the profession. It was entirely the fault of dentists who refused to support the journals with their subscriptions, so that it became impossible for them to continue without subsidy. Regardless of one's viewpoint on "trade journalism" we must in all fairness admit that the privately owned journal played an extremely important part in the evolution of dentistry, and the fact that publishers were motivated by hope of personal profit does not detract from the value of their services.

Many older men still remember gratefully the aid and assistance rendered by some of those periodicals during the years of doubt and confusion while dentistry was struggling towards its professional destiny. We cannot name them all but some of the more important may be mentioned. The *Dental Register of the West,* the *Southern Dental Journal,* the *Dental Summary,* the *Dental Review,* the *Dental Items of Interest* and the most famous of all, the *Dental Cosmos.*

Starting as the *News Letter* by Jones and White in 1847, it became the *Dental Cosmos* in 1859 and for more than three-quarters of a century continued to be the most outstanding dental publication. The influence of the *Dental Cosmos* was felt wherever dentistry was practiced. Recently this great periodical was united with its young but lusty rival, the *Journal of the American Dental Association* which is owned by the membership of organized dentistry. The *Journal* was started as a quarterly bulletin in 1913 and did not become a monthly publication until 1917. Though many conditions may have contributed to the recent high mortality of some of the old publications, there is no doubt that the competition of the *Journal of the American Dental Association* with its circulation of about 40,000 has played a very important part. The only publication which seems to have thrived in spite of the keen competition is the *Dental Items of Interest.*

Started in 1878 as a *Journal of Dental Art, Science and Literature,* the name was later changed to *Dental Items of Interest.* In 1896 the publication came under the ownership of the Consolidated Dental Manufacturing Company and Dr. Rodrigues Ottolengui was appointed its editor, a position which he held for over forty years.

Although keenly interested in the science of dentistry, Ottolengui, as a

realist, recognized that a vocation which is largely mechanical must not neglect the practical side of its daily problems. This was evidenced in the pages of the *Items* during the many years of his editorship. "The Principles of Crown and Bridge Work" by Goslee, "Filling Teeth with Porcelain" by Byram, "The Cast Gold Inlay" by Taggart were just a few of the original contributions of practical value to every dentist which first appeared in the *Dental Items of Interest.*

This brief reference to dental journalism would be incomplete without some mention of the *Journal of Dental Research.* Historically, this excellent publication may be traced to the *Allied Dental Journal* which appeared in 1906, but in its present form dates back to 1923. This journal is devoted exclusively to the science of dentistry and owes its high level of achievement entirely to the unselfish efforts of Dr. William J. Gies. The very existence of this wonderful periodical is an indication that dentistry has grown to professional maturity.

The first dental society in the United States was organized by the dentists of New York in 1834. But it was not until after Hayden and Harris had launched the American Society of Dental Surgeons that the profession began to appreciate the value of dental organization. Several societies were formed in the more populated communities. Among the first was the Mississippi Valley Association of Dental Surgeons, organized in 1844, which continued to wield a powerful influence on dentistry for more than half a century, closing its honorable career in 1896. The Pennsylvania Association of Dental Surgeons was founded one year later in 1845. Its uninterrupted existence to date—for over ninety years—makes it the oldest dental society in the United States, if not in the world.

The effectiveness of dental organizations depended on the accident of leadership and even though some commercially minded leaders have used them to further their own private ends occasionally, as a rule dental societies have stood for the highest professional ideals. In the struggle to raise the level of dental education and in the development of dental legislation to protect the public from incompetents and "charlatans" dental societies played a most important part. This is easily explained since in the very nature of their being they represented disinterested ideals, rather than selfish interest.

From the very beginning, the more intelligent leadership dreamed of a dental organization, national in scope, capable of representing the whole profession. But, while conditions were gradually shaping themselves in that direction, the Civil War broke out and when peace was declared, the

dental profession, like the Methodist church, found itself with two societies, one in the north and the other in the south. Neither of course carried very much influence.

Since dentists are very much like other citizens, a union of the two societies was unthinkable until the older generation, with its tragic memories, had passed away. The relations between the two sections of our country became more amiable and in 1897 it was possible to effect the merger under the name of the National Dental Association.

But the so-called National Dental Association continued to be a sorry affair, really not more than a mutual admiration society for politically-minded dentists. Its membership of 800 was less than that of many state organizations. About 1907, agitation began for a national and all-inclusive association that could really speak for the entire profession. At first this suggestion met considerable opposition as some men feared that in a larger group their prestige and power would be lost. But the spirit of large scale organization was in the air. Trusts and mergers were the topics of the day and some of that spirit seeped into the dental profession. Besides, internal conditions were ripe for a change. Many problems of national scope could not be solved except through collective effort which had arisen. By 1912 most of the opposition was eliminated, and a plan was developed whereby, through a single payment of dues to his local branch society, a dentist became affiliated with his state and national societies automatically. Later the name was changed to the American Dental Association which now includes a membership of two-thirds the practicing dentists in the United States; a great culmination of the work started by Hayden and Harris a century ago!

CHAPTER XVII

THE STRUGGLE FOR BETTER EDUCATION

The chart of social progress never appears as a straight line, but tends to zig-zag up and down. At the lowest point of descent, however, it seldom dips to the level from which the last ascent started. The general trend is always forward. This is true in every phase of human culture; dentistry is no exception.

The founders of the early dental schools believed that they had solved the problem of dental education. They were quite sure that under their plan the training of dental students would continue to improve uninterruptedly until the dentist was recognized as a specialist of medicine on a par with the ophthalmologist or other specialists. Ultimately that is what happened, but those pioneers could not foresee the many impediments that would have to be removed and numerous difficulties that would have to be surmounted until that end was finally achieved.

It has been a hard struggle and has lasted for almost a century. Indeed the profession is just about ready to celebrate the 100th anniversary of the birth of organized dental education. It has been a great century in the history of dentistry and although the battle is not yet completely finished we may now say, unhesitantly, that victory is assured.

Many of the early leaders were physicians. Hayden lectured on anatomy, physiology and therapeutics at the University of Maryland Medical School; Chapin A. Harris, James Taylor of the Ohio School, and several of their associates were students of medicine. Most of them were imbued with the traditions of the older profession, and those traditions quite definitely influenced their attitude in the teaching of the students and the management of their schools.

But, as the number of students increased, commercialism began to invade the field. Some schools were organized solely for profit, and in the competition for students the main purpose was lost sight of entirely. Dental education retrogressed until it reached such a low level that thoughtful men everywhere began to wonder whether complete separation from the medical profession had not been a grave error.

Fortunately, shortly after the Civil War, the dentists in the city of Boston seemed to have possessed some of the spirit which prompted Hayden and Harris in their pioneer efforts a quarter of a century earlier. At the first annual meeting of the Massachusetts Dental Society in 1865, Dr. Nathan C. Keep in his presidential address suggested the possibility that Harvard might appoint professors of dentistry and confer the degree of "Doctor of Dental Surgery." Dr. Keep must have been a very courageous man even to intimate that staid old Harvard should take dentistry under its protective wing. It is doubtful if many of those present believed such a thing possible. Nevertheless a committee was appointed to discuss the matter with the proper authorities. The most they hoped for was to obtain a chair of dentistry in the Harvard Medical School. But, surprisingly enough, after several conferences, the idea grew into a plan for a school of dentistry as an integral part of Harvard University, and in 1867 the Harvard Dental School was organized with Nathan C. Keep as its first dean.

It is to the credit of the famous institution that even at that early date its far-sighted leaders recognized the close relationship between the two professions. Their attitude was succinctly expressed by Dr. Oliver Wendell Holmes at the first graduation exercises, when Dr. Holmes referred to dentistry "as a branch of the medical profession to which this graduating class has devoted itself" and closed "yours is now an accepted province of this great and beneficent calling—medicine."

The influence of Nathan C. Keep and his professional standing was without question a very deciding factor in Harvard's decision, and his name deserves to be linked with those of Hayden and Harris, as one of the founders of dental education. The University of Michigan followed Harvard's example in 1875 and the University of Pennsylvania began training dental students in 1878.

Harvard's entrance into the field (although its effect was not realized at first) was the beginning of a movement in dental education equal in importance to the founding of the Baltimore school twenty-five years earlier.

In 1884 there were 22 schools in the United States, most of them privately owned, a few rather loosely affiliated with some university, and a lesser number operated as departments of universities. Standards of dental education and entrance requirements varied with the different institutions. In most schools, any student who was able to pay tuition was welcomed. If he had not attended the prescribed two years of high school, he could usually find some county superintendent who would give him an "equivalent certificate" for a reasonable fee.

As educational institutions, the universities attempted to exert their influence towards better teaching standards and insisted upon admission requirements more nearly in line with those demanded by their other departments. To give force to these demands they organized about half the better schools into an association whose aim was to raise the level of dental education. But there was considerable disagreement within the group and, in order to satisfy the private owners, a compromise was reached by adopting the standards which Harvard had set for itself when it first opened its dental school seventeen years earlier, in 1867.

Harvard was not pleased with the compromise and finally withdrew from the association. The cleavage came upon Harvard's refusal to accept the plan of four year's professional training, preceded by two years high school, Harvard authorities believed that they could turn out better trained dentists in three years, if the students had previously spent four years at an accredited high school.

For the private dental colleges this was more than an academic problem. Higher entrance requirements meant a smaller supply of students and a three-year dental curriculum, smaller tuition fees and also decreased income in the clinic.

The prime object of many private schools was of course to make money. They were usually organized as stock companies and in some instances the directors elected themselves to professorships at fancy salaries to teach subjects about which they knew very little. The various sciences were taught perfunctorily. There is a record of one school with an enrollment of about six hundred and fifty employing one instructor at sixteen hundred dollars per year to teach three scientific subjects.

Even competent teachers were expected to be less exacting with dental students. A student who had complied with his technical requirements and completed his "points" had no cause to worry about his graduation because of deficiency in theoretical knowledge. The atmosphere at most private dental colleges was more nearly that prevailing in trade

schools, and this attitude naturally permeated to the student body, who gave but scant attention to any subject excepting those pertaining to the technical side of dentistry. Knowledge of anatomy, chemistry or histology was considered useless and a sheer waste of time.

It would be unfair, of course, to condemn all private schools. Many were owned by honorable men, fully conscious of their professional obligations. They employed a competent staff of teachers and their graduates were reasonably well trained. But the profit motive frequently forced the proprietors of the well managed schools to join with the less ethically conducted institutions, and against the higher aims and ideals of the university schools. Even the brilliant work of Miller and Black during the decade following 1885 was unable to stem the tide of retrogression, and at the close of the century dental education reached its lowest ebb.

Conditions, however, were not as dark as they appeared on the surface. At that time, although they seemed to dominate the field of dental education, actually, the position of the private schools was being undermined slowly. In 1908 the number of university controlled schools was sufficiently large to organize a Dental Faculties Association of their own, and because of their resources and prestige this group (though a small minority) were able to assume leadership which the private schools had to follow.

Just how long it might have taken under normal circumstances to have reached a proper standard of dental education it is impossible to tell now. The private schools were well entrenched and their owners were not ready to give up their profits without a hard struggle.

When, quite unexpectedly, Hunter made his famous attack on American dentistry calling attention to the seriousness of "oral sepsis," and soon after Billings and Rosenau promulgated their "localization" theory, these findings caused considerable agitation within the profession. The rank and file began to realize what a small minority had long suspected—the very intimate relation between the teeth and general health. Physicians, too, who had previously paid no attention to oral conditions, became keenly interested in focal infection around the teeth. This new information quickly seeped down to the laity, and the public in general began to appreciate the dire possibilities of poor dentistry.

Those who had maintained that the dentist's formal education or his familiarity with the biological sciences was unimportant, could no longer defend their position. The demand for a better trained profession could no longer be resisted. Within five years conditions in all schools were

decidedly improved and four years of accredited high school, not an "equivalent," became the universal entrance requirement by 1917.

In 1921, several colleges began to demand an extra year of collegiate work and some stronger schools raised it to two years, which had to include the study of chemistry, physics and biology. Most of the dental examining board quickly fell into step and dental education began to make rapid strides. As the standard of dental training had at last approached the level of medical education, economic factors automatically came into play. A student's tuition, including even the profits in the clinic, ceased to pay the cost of his instruction. The training of dentists, like the training of physicians, had to be subsidized. Private schools were unable to provide proper teaching and laboratory facilities and still continue to make a profit, and so most of them had to close.

But the solution of one difficulty frequently raises new problems. Sometimes these problems are inherent in the original solution. Having arrived at the conclusion that dentistry is a specialty of medicine, the question which the colleges had to answer was, "Just how much instruction in the medical sciences should a prospective dentist receive."

A few insisted that, like other medical specialists, the dental student should be given a complete medical education, followed by a full course in dentistry. However, to the more thoughtful, this seemed illogical. They could see no reason for filling the minds of dental students with information which was not even remotely connected with their daily work. In their opinion that would be a sheer waste of time and effort. Besides, proficiency in both fields would necessitate the extension of the dental curriculum even beyond that required for the practice of medicine, and would tend to discourage young men from entering the profession. The number of dentists would fall below the normal requirements for adequate community health.

Several teachers believed that these objections could be surmounted by dividing the practice of dentistry into definite and distinct divisions among two differently trained groups; stomatologists, who would take degrees in both professions, and technicians, without knowledge of bodily structures or functions, but with a few years of training in dental mechanics enabling them to perform operations upon the teeth, under the guidance and supervision of a stomatologist.

Most dental educators however objected to this plan for fear of the demoralization which they believed would follow such a scheme. Within a short time the technicians would dispense with the stomatologists and

set up in practice for themselves, surreptitiously and illegally at first, but later quite openly under laws obtained from the legislatures through political pressure. The resulting deterioration in dental service would be calamitous. Both the profession and the public suffering untold harm, and the battle for raising the standards of dentistry which has been waged during the past hundred years would eventually have to be fought all over again. Furthermore, such an arrangement could only operate successfully in clinics employing several technicians to each stomatologist, and it has not yet been proved that the introduction of these institutions into dentistry would serve the best interest either of the profession or patients.

The few remaining private schools, aware of their inferiority as teaching institutions under the new conditions, saw in this confusion of ideas an opportunity to bolster up their weakened position by raising the cry of over-education hoping that this would help them to continue their existence. This cry found a sharp echo in many quarters, for although the rank and file were entirely apathetic to the discussions that were agitating the pedagogues, they were deeply concerned with the progress of their profession. American dentists have always been proud of their achievements and their superiority which they attributed to the independent development of dental education in the United States, and they were ready to resist any change which they believed would retard that progress. They feared that the introduction of the European system in which dentists are medically trained, would lower the level of restorative service.

Those in charge of the schools also had misgivings regarding future trends. They, too, wondered whether, as a result of a closer connection with medicine, dentistry might not forfeit its supremacy in the technical field and if so what might be the ultimate effect on the quality of services rendered to the patient.

Fortunately, amid this doubt and confusion the Carnegie Foundation agreed to inaugurate a complete survey of the subject, placing the work under the direction of Dr. Wm. J. Gies. This was a particularly fortunate choice, as Dr. Gies was a prominent educator with long years of university association and although not a dentist, he had been keenly interested in dentistry and its problems.

Space does not permit going into details of Dr. Gies' research. His report cleared up many problems and his conclusion, based upon a very thorough analysis was, that whereas dentistry must be closely related to medicine, it should retain its independence and continue its separate existence. Dental educators have since followed many of the suggestions

which appeared in that report and dental education is gradually developing along the lines suggested by Dr. Gies.

Now that the struggle is nearly over we may well ask, has it been worth while? Might it not have been better if Hayden and Harris had taken the advice of their friends and had not made the cleavage? Has the separation from medicine been a wise move? The condition of dentistry in Europe will give the best answer to that question. In most parts of the old world where dental education came under the control of medical authorities from the very beginning and greater emphasis had been placed on the biological sciences, at the expense of technical training, this emphasis resulted in making the European dentist better educated but (usually) less competent in mechanical aptitude than his American colleague. In recent years the deficiency in the education of American dentists has been corrected, but the mechanical technique of the average European dentist is still below the standard prevailing in the United States.

The concentration upon mechanics in our earlier schools which was the direct result of dentistry's separation from medicine gave American dentistry another advantage which Europeans missed. Individuals with fine digital skill and technical ability were often attracted to the profession and their creative ingenuity has given impetus to the progress of restorative dentistry to a degree not found anywhere else in the world.

CHAPTER XVIII

HUMANITY'S EFFORT TO CONTROL PAIN

In the third chapter of Genesis, we are told that, "The Lord caused a deep sleep to fall upon Adam, and he slept; and He took one of his ribs and closed up the flesh instead thereof." Evidently the author could not imagine that the Lord would subject Adam to severe pain, and he therefore decided that the operation must have been performed under deep sleep, which, according to the author's own experience, was the nearest approach to insensibility. The story also suggests an unconscious expression of a wish, the elimination of pain through sound sleep. The Lord alone could perform such a miracle. Indeed for thousands of years the wish remained unrealized, for not until the middle of the nineteenth century, has it been possible to produce "anesthesia," a sleep so deep that the removal of a tooth or a rib does not disturb the patient's slumber.

Narcotics have been known since remotest time, for pain is the concomitant of life. Man opens his eyes upon this world with a cry of pain caused by the rush of air into his collapsed lungs, and a sigh of pain usually accompanies his last breath. It is more than probable that when man left the forest and began his wanderings on the sunny plains, he immediately started to search for some agent to ease his sufferings during illness or after a severe injury. Early medicine men were not concerned with preventive or corrective hygiene. They applied themselves almost entirely to the treatment of symptoms manifested as aches and pains.

Hashish made from the tops of the Indian hemp-plant and smoked like cigarettes has been used as a narcotic throughout the East from the beginning of time. Opium, the milky exudate of the unripe poppy, was popular for its narcotic properties in China thousands of years ago. The Greeks were also familiar with it. Mandrake, a plant common to the shores of the

Mediterranean, was common in Rome as a narcotic in the time of Nero. The early Hebrews, too, knew this drug as may be seen from the following passage in Genesis:

"Reuben went in the days of the wheat harvest and found mandrakes in the field, and brought them to his mother Leah. Then Rachel said to Leah, 'Give me, I pray thee, of thy son's mandrakes.'—But Leah refused, and so Rachel said,—'Therefore shall he lie with thee tonight for thy son's mandrakes.' This offer must have been acceptable for when Jacob was coming out of the field in the evening Leah met him and said, 'Thou must come in unto me, for surely I have hired thee with my son's mandrakes!'" Evidently father Jacob had no say in the matter, at least his objections are not recorded. Mandrake was also employed frequently during the Middle Ages, but it is not a very effective narcotic, and so we do not hear much about it today.

Unfortunately all these narcotics were valueless in tooth extraction, and the operation continued to be dreaded by people everywhere and during all ages. Today when even a hang-nail is seldom removed without some form of anesthetic, it is almost impossible to imagine the torments of tooth extraction without gas or procaine.

Probably one of the reasons for the delay in the discovery of general anesthetics was the fact that the effect of the drug could be obtained only by inhalation. Medication through the nose did not come as naturally as the chewing or swallowing of narcotics. But a second and a more difficult problem was the finding of such agents. Anesthetics are artificial products. Unlike opium and similar drugs their ingredients do not occur free in nature. Mankind first had to acquire the knowledge of how sulphuric acid and alcohol may be made. And then it took a long time to learn how they might be combined into volatile inhalable ether.

The invention of ether is credited to an Arabian chemist, Yeber, who lived early in the twelfth century. For hundreds of years, however, it remained a laboratory curiosity of the alchemists. Finally it was discovered that ether possessed exhilarating properties, like alcohol, and people began to use it for "ether jags" or "ether frolics" as they have been called in this country.

Often in isolated communities where life was dull and lonesome, some of the young blades would take ether for its intoxicating effects, and the antics which they performed during the "jag" helped to amuse the older people present. This practice of ether inhalation was responsible for the first surgical operation performed under its influence.

At an ether frolic held one evening in the home of a Dr. Ware near

Athens, Georgia, a colored lad was given some ether and the company prepared to watch his antics, which they expected would add to their merriment. But in the general enthusiasm an overdose must have been administered for the boy fell on the floor totally unconscious. The merrymakers became very much frightened thinking they had killed the poor fellow and sent for a physician. However after an hour or more the boy revived and was apparently none the worse for his experience.

Among the spectators at the party was a certain Mr. Wilhit, who later decided to study medicine and became a pupil of Dr. Crawford W. Long, a practicing physician at Jefferson. This town was not unfamiliar with ether frolics. In fact Dr. Long himself had often joined such parties and once, while under the influence of the drug, had bruised himself rather severely, but upon regaining his senses could remember no pain. When he mentioned this incident to Wilhit, the latter told him about the negro boy whom he had observed some time previous at the Ware party. This must have made a strong impression upon Dr. Long, for shortly after, when a friend (Mr. James Venable) came in with a bad boil on the back of his neck, which required a lancing and which promised to be excruciatingly painful, the doctor suggested the use of ether. Venable who was no stranger to ether frolics was willing to try it in the hope of escaping the pain. Dr. Long allowed him to inhale ether until unconsciousness had set in; then excised the tumor without the least inconvenience to the patient, thus performing the first surgical operation under a general anesthetic ever recorded in the history of the world; in the year 1842.

There is no question that Dr. Crawford W. Long was the original inventor of ether anesthesia. But living in a small town, far away from the center of population, where communication was poor and news traveled slowly, his great discovery remained unknown for several years. In the meantime Wells and Morton, who had heard nothing of Dr. Long's work had introduced anesthesia to the world and with better opportunities for the dissemination of their discoveries received the credit which might have gone to Dr. Long.

The state of Georgia, with pardonable pride, placed a statue of her native son, Dr. Long, in the Hall of Fame in the capitol at Washington. For us, however, his pioneer efforts have only an historic interest. Whatever he did was of no help in accelerating the progress of pain elimination from surgical operations. Humanity had to wait a while longer before it became possible to induce that sleep which the biblical writer thought no one but the Lord could cause.

CHAPTER XIX

GAS THAT LAUGHS AT PAIN

"Laughing Gas" which, with a few inhalations, stimulates some people to hilarity and others to fight like demons, was first synthesized in 1773 by an English minister, Joseph Priestley. In comparison, this gas is no different from the air we breathe, except that it contains only a fourth as much nitrogen and twice as much oxygen.

Shortly after this discovery, several people became interested in the "new air." Some conducted experiments on it in connection with the treatment of respiratory diseases. One, Sir Humphrey Davy, an Englishman, discovered that when the inhalation of the gas was carried beyond its stimulating effect, it was capable of destroying sensibility to pain. According to some reports, Davy had one of his own teeth extracted while under the influence of the gas and expressed the opinion that "it might be useful in surgical operations."

Very little significance was attached to this suggestion, and Priestley's discovery remained a laboratory curiosity. A number of years later the following advertisement, inserted by a certain Mr. Colton, a popular lecturer on scientific subjects, appeared in the Connecticut Courant of Hartford:

"A grand exhibition of the effects produced by inhaling (NITROUS OXIDE) EXHILARATING OR LAUGHING GAS will be given at UNION HALL, This (Tuesday) EVENING, December 10, 1844.

"Forty gallons of gas will be prepared and administered to all in the audience who desire to inhale it.

"Twelve Young Men have volunteered to inhale the Gas, to commence the entertainment.

"Eight Strong Men, are engaged to occupy the front seats to protect those under the influence of the Gas, from injuring themselves or others.

"This course is adopted so that no apprehension or danger may be entertained. Probably no one will attempt to fight. The effect of the Gas is to make those who inhale it either Laugh, Sing, Dance, Speak, or Fight, etc, etc, according to the leading traits of their characters. They seem to retain consciousness not to say or do that which they would have occasion to regret.

"N.B. The Gas will be administered only to the gentlemen of the first respectability. The object is to make the entertainment a genteel affair.

"Those who inhale the Gas once, are always anxious to inhale it a second time.

"There is no exception to this rule.

"No language can describe the delightful sensation produced. Robert Southey (poet) once said that 'The atmosphere of the highest of all possible heavens must be composed of this Gas.'

"Mr. Colton will give a private entertainment to those ladies who desire to inhale the Gas, Tuesday, between 12 and 1 o'clock, FREE. None but Ladies will be admitted.

"Entertainment to commence at 7 o'clock. Tickets 25 cents."

Among those attending the lectures and exhibitions were Dr. Horace Wells, a dentist practicing in Hartford, and his young friend Cooley. When Colton called for volunteers, Cooley, among others, went up on the platform and inhaled a few whiffs of the gas. But instead of singing, dancing, or laughing, he began to fight and in the struggle that followed he caught his leg on the back of a bench, which sent him sprawling on the floor. The shock restored his scattered senses and he slid back quietly into his seat beside Wells. After a few moments, the latter noticed a pool of blood on the floor in front of him. Upon examination, he found a wide gash on Cooley's leg, bleeding profusely. Such an injury would usually cause considerable pain, but Cooley did not remember having been hurt at all or feeling any sensation whatever when his leg struck the sharp edge of the bench.

At that moment Dr. Wells' mind must have jumped across a gap and made direct connection between the incident he had just witnessed and his own daily experience. If a few inhalations of this gas would make a man insensible to the pain of such a severe cut, might it not be used for the painless extraction of teeth? Dr. Wells became so excited by this thought that he could not go home. He went to talk the matter over with a dentist friend of his, Dr. Riggs, also practicing in Hartford. (Pyorrhea has for a number of years been called Riggs' disease in this country, as a tribute to his effort in that field.)

Riggs was not very encouraging. But early the next morning, Dr. Wells visited Mr. Colton and arranged with him to administer the gas to a patient

for the extraction of a tooth. Upon further consideration he decided that he would try the experiment upon himself. Nothing but first hand information would satisfy him and he was willing to extract one of his good molars to obtain it.

The operation took place in Wells' office early in the afternoon of December 11, 1844. Colton administered the anesthetic and Dr. Riggs removed a large perfect molar from Wells' upper jaw. During the extraction, Wells remained entirely tranquil, showing no evidence of pain. He remained unconscious for a few minutes and when he awoke exclaimed: "A new era in tooth-pulling. It did not hurt me as much as the prick of a pin. It is the greatest discovery ever made."

Wells did not exaggerate. He had indeed made a great discovery. Anesthetics have enabled surgeons to perform miracles of life-saving that even the most optimistic visionary never imagined possible. Some day, perhaps, when humanity is much wiser than it is now and exploits of mass murder have ceased to gratify the national sense of superiority, December 11th may be celebrated all over the world as a holiday, commemorating the realization of an age-old dream—Man's Victory over Pain.

After using the gas successfully in his own practice for some time, Wells decided to give the invention to the world. Unlike Long, Wells lived in the center of population in New England. Accordingly he came to Boston, where, after some effort, he succeeded in obtaining permission from Dr. J. C. Warren, senior surgeon at the Massachusetts General Hospital, to give a demonstration in one of the clinics.

But fortune did not favor Wells that winter morning, early in 1845. The amphitheatre was crowded with students and physicians who had come to see the "show"; the physicians did not believe that anything original or important could be contributed by a "tooth carpenter." Wells, a highly sensitive man, felt the unfriendly atmosphere and was very nervous. His crude apparatus did not function smoothly. The patient was not inhaling the gas properly, and the audience became more and more tense. In his anxiety, Wells finally told the surgeons to start operating. But the man was not completely anesthetized and when the knife touched him shrieked with pain. Immediately the doubting audience turned into a jeering and hooting mob, and poor Wells left the hospital shame-faced. What he had hoped would be a great triumph turned out a dismal failure. People were calling him a fake; an imposter.

The incident weighed so heavily on Wells that he soon fell ill, and went to Europe to try to regain his health. Some news of the operation had

DR. JAMES TAYLOR

James Taylor, M.D., D.D.S. (1809-1881), was born in 1809 at Grove Farm, near Bainbridge, Ross County, Ohio. As Harris blazed the trail for dental journalism in the east, so did James Taylor, only a few years later, assume a similar relationship to dentistry in the west. As early as 1847 Taylor became the editor of the newly founded *Dental Register* of the west. It is doubtless a significant coincidence that these two pioneers in dental journalism (Taylor and Harris) received their tutelage in dentistry under the same man, John Harris of Madison, Ohio, an older brother of Chapin A. Harris. Taylor was also the leader in the establishment of a school for dentists in the west—the Ohio College of Dental Surgery—in 1847.

The journal which he edited enjoyed a continuous publication for some seventy-seven years, discontinuing publication in 1923, and today its pages reflect the inspired efforts of this great leader in establishing periodical literature on the high standard it maintains today. He was contemporaneous with the famous amalgam war, being among those who refused to sign the now famous "amalgam pledge," and he used his journalistic influence in preventing his colleagues from adopting a radical stand on this or any other subject that might handicap the progress of the newly established profession.

DR. NATHAN C. KEEP

Nathan C. Keep, M.D., D.M.D. (1800-1875), was born in Long Meadow, Massachusetts, in 1800. In his preparation for professional work, he served an apprenticeship in dentistry and practiced that profession until he was some twenty-five years of age, when he attended the Harvard Medical School and received the M.D. degree in 1827. In his practice of dentistry he felt the need of more knowledge of medicine, and hence acquired the M.D. degree purely as an aid to intelligent dental practice.

While he never practiced medicine, he was an ardent advocate, after dentistry came to be recognized as a separate profession, of medical education as preparatory to dental practice. It was this conception of dental education that led him to take a prominent part in the establishment of the Harvard Dental School in 1868, as an integral part of the university system. It was thus that Harvard Dental School became the first dental school to be associated in the university plan of education.

He was a highly skilled dentist, a broad-minded man, and labored constantly for the establishment of dentistry as a liberal profession. Dr. Keep attained considerable fame in his connection with the famous Webster-Parkman murder case, in identifying the victim by means of dental work he had done in Dr. Parkman's mouth. This is probably the first instance recorded in this country of identification by means of teeth.

reached France. So, while in Paris, he was requested to appear before a notable gathering of French academicians to give a demonstration of the gas. Without enthusiasm and with many misgivings, Wells appeared and gave a half-hearted lecture and demonstration, which, however, was much more successful than he had expected. But upon his return, he found that the Boston fiasco still cast a shadow upon his reputation. Some men claimed that the gas had no merit at all and was worthless as an anesthetic.

The first recognition for his wonderful contribution came from Europe. France conferred upon Wells the honorary degree of M.D., and on January 12, 1848, the Paris Medical Society voted that "to Dr. Wells of Hartford, Connecticut, in the United States of America, is due all the honor of having first discovered and applied the vapors of gases whereby surgical operation could be performed without pain."

They also elected him an honorary member of their society. Unfortunately all this came too late. Before the good news reached him Dr. Horace Wells had died. In his despondency over the treatment he had received from his own countrymen, he committed suicide by cutting an artery in his wrist. A tragic end for this great benefactor of humanity!

CHAPTER XX

THE DISCOVERY OF ETHER ANESTHESIA

Among the spectators at Wells' unlucky demonstration at the Massachusetts General Hospital were two men who later played an important role in the final establishment of inhalation anesthesia. One was Dr. W. G. T. Morton, a dentist practicing in the city of Boston, and a student in the Harvard Medical School. The other was Dr. Jackson, a physician and chemist of considerable ability.

Morton was one of the first graduates of the Baltimore Dental College. He had met Wells there; they formed a partnership after their graduation, opening an office in Boston. Later, for some unknown reason, Wells moved to Hartford. Jackson and Morton were very friendly, having offices in the same building. When Morton began to study medicine and had to choose a preceptor from among practicing physicians he selected Jackson. Their friendship is important on account of the controversy over priority rights which followed the invention of ether anesthesia.

Early in the forenoon of September 30, 1846, Dr. Morton called on his friend Jackson. He wanted information on the manufacture of laughing gas. Jackson advised that the process was too complicated and required rather elaborate apparatus. He asked Morton why he wanted the gas, and the latter explained that he intended to experiment with it for the painless extraction of teeth. Perhaps Morton had heard that Wells, in spite of his lamentable failure, had continued to use gas in his practice with considerable success. Hartford was not far away. It is also possible that he had spoken to Wells himself about it.

Since the gas was hard to obtain, Jackson suggested ether as a substitute, telling him that it would produce the same effect with much greater safety. Besides it could be more easily obtained. Morton lost no time in

making the experiment. That very evening he administered ether to one of his patients and extracted a large molar painlessly. The ease and simplicity of the operation amazed Morton. Painless extraction—even painless surgery—had become a reality! He alone knew the secret!

Having stumbled upon such a marvelous innovation Morton saw the prospect of fame and fortune ahead of him. He was going to make sure that it would not slip away from him!

Early the next morning Morton visited the office of Mr. Eddy, a patent attorney and made arrangements for the filing of a patent application. The lawyer thought, however, in view of the fact that Jackson had advised the use of ether, possible litigation might be eliminated if he were allowed to share in the patent. But Jackson did not want to be connected with a patent on a process to be used for the alleviation of human suffering because that was contrary to the ethics of the medical profession. Nevertheless, he agreed to sign the application as an accommodation to his friend and then transferred his rights to Morton.

Shortly afterward, Jackson did a rather strange thing. He mailed the following communication, securely sealed, to a friend in Paris, with instructions that it be lodged in the archives of the Academy of Arts and Science, and remain unopened until he gave his consent:

"I request permission to communicate through your medium to the Academy a discovery which I made and which I believe important for the relief of suffering humanity as well as of great value to the surgical profession. Five or six years ago, I noticed that peculiar state of insensibility into which the nervous system is thrown by the inhalation of the vapor of sulphuric ether. I have lately made useful application of this fact by persuading a dentist to administer the vapor of the ether to one of his patients, when about to undergo the operation of extraction of teeth. It was observed that such person suffered no pain in the extraction of teeth, and that no inconvenience resulted from the administration of the vapor."

This was dated November 15, 1846, just one month after Morton had given a successful demonstration of the ether before the medical profession of Boston. Jackson was evidently attempting to save what he could of credit and honor that he felt was due him.

The demonstration took place on October 16, 1846. Dr. J. C. Warren who was still senior surgeon at the hospital had not forgotten the laughing gas incident of the previous year and was inclined to be skeptical. But Morton was persistent and finally obtained Warren's consent. On the appointed day the clinic was filled with the same crowd that jeered at Wells

and who expected another good laugh at the expense of another "ignorant tooth-carpenter."

The operation was scheduled for ten o'clock in the morning. A tumor was to be removed from a young man's neck. Morton had some difficulty with his inhaler, and consequently was late in arriving at the clinic. Warren, becoming impatient, was about to start the operation without the ether when Morton came in, quickly adjusted the inhaler, and began to administer the ether.

The audience, entirely skeptical waited for something to happen, but was disappointed. Everything seemed to work smoothly. The patient gradually lost consciousness, and fell into a deep slumber. When Warren made the incision there was no scream; no struggle. It seemed like black magic. The spectators became silent and tense. When he had finished, Warren broke the deep quiet: "Gentlemen, this is no humbug!" His associate, Dr. Bigelow, chimed in, "I've seen something today that will go around the world!" Several other operations under ether followed in rapid succession with uniformly good results and the seal of authoritative approval was set upon the use of ether in surgical operations.

But the road of the inventor is not always smooth. As soon as the noted Boston surgeons endorsed the use of ether, Jackson published a little pamphlet setting forth his own claims to priority. He told how he had accidently inhaled some chlorine gas and sought relief from the irritation of his mucous membranes by breathing in some vapor from a towel soaked in ether. He described the effects:

"The irritability ceased, a sense of coolness followed by warmth, giddiness, and exhilaration, numbness, and a swimming sensation, as if afloat in the air. I soon fell into a dreamy state and then became unconscious of all surrounding things. When I awoke the pain in the throat was gone; my limbs were benumbed and the nerves of sensation paralyzed and it was some time before I fully recovered that the pain in my throat returned. Reflecting on this phenomenon, the idea flashed in my mind that I had made the discovery I had for so long at a time been in quest of—a means of rendering the nerves of sensation temporarily insensible, so as to admit of the performance of a surgical operation on an individual without any suffering of pain on his part."

Morton and his friends naturally claimed that all this was an afterthought on the part of Jackson and that he was now trying to edge in on Morton's discovery. But they of course could not deny that the suggestion to use ether came from Jackson, and a bitter controversy ensued. Soon Wells' friends also joined the fight, insisting that Wells was really the originator of anesthesia, and that Jackson and Morton had merely substi-

tuted a different vapor. In turn, the latter denied that nitrous oxide had any merit at all. The acrimonious discussion continued for some time.

Now, after about a hundred years, we can evaluate the contribution of each of the three men. Wells, of course, was the originator of anesthesia by inhalation. Jackson found that ether vapor would cause insensibility, but apparently did not have the courage or the interest to make a test. Morton popularized anesthesia by demonstrating the practical use of ether. Credit for the final result belongs to all three men. Together they share the honors of the invention. Today nitrous oxide, or laughing gas, is in standard use in dental offices for extraction. Ether, chloroform, and some of the newer agents are preferred in general surgery when the operation is of longer duration.

Morton, unfortunately, had more serious troubles than disputes with Jackson. Ether is not an entirely harmless drug and the dangers involved in its administration by inexperienced men resulted in many unexpected fatalities. *Even at present, in spite of the skill of trained anesthetists, an occasional loss of life is unavoidable.* And because of these frequent fatalities, physicians all over the country began to condemn Morton's discovery.

Medical men have often been as unscientific as laymen in their conclusions. They laughed at Jenner and his small-pox vaccines. They ridiculed Pasteur, and derided Lister and his methods for prevention of infection in surgical wounds. It is therefore not surprising that some of them rose against Morton. To cite only two examples:

Dr. Thomas E. Bond, professor of Pathology at the Baltimore Medical College, on December 16, 1846, wrote a letter of protest to the Boston Medical Journal in which he stated, "I verily believe the great discovery utterly useless. In this part of the world it has failed utterly." Dr. James H. Bickford, another prominent physician, addressed a solemn warning against the use of ether, "that it causes a chemical alteration in the vital constituents of the blood. Hence the blood takes a long time to regain its life-supporting, flesh-forming characters; wounds refuse to heal and the patient often sinks into death."

Morton's most severe blow came from men in his own profession. The dentists of Boston published a signed statement in one of the newspapers, condemning the use of ether and predicting dire calamities to those who used it. Other people also took a hand in the affair. The clergy stated that since pain was a dispensation of Providence, a consequence of original sin, Morton's discovery was, therefore, in direct opposition to the will of God. One minister wrote of ether as "a decoy in the hands of Satan," and an-

other feared that ether "will harden society and deprive the Almighty of the deep earnest cries that rise, in time of trouble, for help."

Terrible pictures were drawn of the use of ether by thieves and housebreakers who would put their victims to sleep before robbing them of their valuables, endangering the welfare of the community. Thus, far from being hailed as the originator of a new idea which was a great boon to humanity, Morton was looked upon as an enemy to society and a menace to the peace and morals of the community. His dental practice was broken up and his private life viciously attacked. In one small town near Boston they even burned him in effigy.

Morton of course was not wholly without friends. A few intelligent men, like Warren, Bigelow, and the philosopher physician, Dr. Oliver Wendell Holmes, appreciated his great services and supported him to the best of their ability. But the hysteria of the mob, the stupidity of his professional colleagues and the misguided religious zeal of the "good people" were too much for him. One morning he was found unconscious by a policeman in Central Park, New York, and an ambulance was called and before reaching the hospital Morton had died.

Dr. Jackson died five years later in an insane asylum at Somerville, Massachusetts. Long, the last survivor of the four men connected with the great discovery, was stricken with general paralysis while attending a woman in labor, and after lingering for some time, died in 1878. It is strange indeed that all these men should have ended tragically. The ancients used to tell of the jealousy of the Gods, and how they punished the thief who stole the fire from heaven!

CHAPTER XXI

THE FINAL VICTORY

The discovery of chloroform by an English doctor, shortly after the introduction of ether and laughing gas in this country, gave the medical profession three perfect pain-controlling inhalants, each suitable to the varying circumstances which might arise. But the dental situation was different. Gas was an excellent agent to be used during extraction, safe and easy to administer. But tooth removal was just one phase of dentistry. It was impractical to give an anesthetic when the patient's mouth had to be kept open for a long time. Grinding teeth, and, more particularly, killing of the pulps could not be done properly while the patient was unconscious.

The same difficulty was encountered when deeply embedded or crooked roots had to be removed. The operation was simpler and more successful when the patient was fully conscious and the dentist could work slowly and deliberately. Protracted anesthesia in the dental chair added to the nervous tension of the operator, and occasionally interfered with his efforts. Dentistry's most pressing need, then, was a drug which would inhibit sensation in the tooth, gum, or nerve alone, instead of putting the brain to sleep and rendering the whole body unconscious.

By the middle of the nineteenth century, science had made considerable progress. Men everywhere began to find new methods to increase humanity's control over environment. Carl Koller, a young medical student, while he was looking for something to ease throat examination, discovered that a cocaine solution would lessen the spasms of gagging and coughing. Shortly afterward, eye doctors found that a two per cent solution would give complete insensibility to the eyeball. In 1889 Dr. Halstead of New York injected cocaine and blocked the nerve of the lower jaw. This was the beginning of local anesthesia.

The injection was done with a hypodermic needle, a British invention dating back to 1843. The first use of the contrivance was recorded during the Civil War. A wounded soldier had his lower jaw shattered, and chloroform could not be administered. The surgeon procured a syringe, injected some morphine deep into the nerves of the jaw, and performed the operation without apparent pain to the soldier. But morphine was not a satisfactory local anesthetic and the idea of relieving pain by hypodermic injection remained dormant until cocaine was perfected.

Cocaine is a derivative of coca leaves, a plant indigenous to South America. The natives chew it very much as we chew or smoke tobacco. The Spaniards found the habit almost universal among the Indians, particularly those living on the high plateaus. The effect of coca is very remarkable. It enhances bodily vigor, stills hunger and decreases the desire to sleep.

Indians have been known to follow the jungle trails for three or four days, running steadily at full speed without food excepting a package of coca leaves in the pouch of their belts. Of course one cannot live on stimulants. Eventually, the reckoning comes, much the same as the attempt to stay on the job with the aid of the whiskey bottle.

While coca chewing is undoubtedly habit forming and degenerating when used to excess, its effect is not nearly as bad as the sniffing or the injecting of the drug in its crystalline form. In fact, some believe that in moderation the use of the leaf is comparatively harmless.

Cultivation and chewing of coca dates back to the first Incas. The Indians employed coca in all the important events of life—at births, at wedding feasts, and it was placed in the mouths of the dead at burials. Coca leaves were usually burned as an offering to the sun, and to produce smoke at the great sacrifice.

The Catholic clergy, anxious to eradicate pagan rites and ceremonials, attempted to stop this practice among the natives by law. But the Spanish mine owners and planters found that the Indians whom they had enslaved could be made to work harder on less food when allowed to indulge in the habit. They defied the church and, as usual, profits won. The underfed and overworked Indians died like flies. In Peru, alone, the population decreased from about eight million to slightly more than one million. The same thing happened in other parts of South America.

As a local anesthetic cocaine was very useful. But it had several serious disadvantages. It was poisonous and habit forming. Some people had an idiosyncrasy for the drug and would be affected by the smallest of doses.

Deep injection sometimes caused serious sloughing of the tissues. Yet it was generally used, until procaine (novocaine) was developed, in the early years of this century, because there was nothing to take its place.

Procaine (novocaine), an artificial product discovered by Einhorn in 1905, possessed all the good qualities of cocaine and none of its faults. There is hardly an operation that cannot be performed with the aid of this drug. It is particularly valuable in dental surgery. The most difficult extraction can be done painlessly. Procaine (novocaine) can be injected into the soft tissues of the gums or directly into the nerves, without harmful effects. Mutilation of the jaw following tooth extraction is now very rare because the dentist can take all the time he needs and handle the tissues carefully. Though tooth grinding is unpleasant, procaine (novocaine) eliminates the pain from cavity preparation.

The practice of killing the pulp dates back to Fauchard or even earlier. Fauchard, as we have seen, suggested the insertion of a red-hot wire into the canals. This was burning the pulp alive, a very effective method. No pulp could possibly outlive such treatment. It is a question, however, whether this was ever actually done and how many patients had the fortitude for it.

The first rational method for killing pulps was suggested by Dr. S. Spooner (Shearjasub Spooner) who like many dental pioneers hailed from the city of Baltimore. Like his contemporaries, he probably used arsenic occasionally to stop toothaches. This was an ancient remedy. The Chinese knew about it hundreds of years ago. A small pellet of arsenic was placed in the aching tooth, and the ache passed away. But no one had ever tried to find out why. Spooner discovered the reason; arsenic killed the pulp.

After this he began to use the drug deliberately for the killing of pulps in teeth which he wanted to save. This practice became popular in the United States from about 1856, and shortly afterwards was adopted in foreign countries. Gutta percha root canal fillings are reported in 1857.

Arsenic, if left in too long, is apt to penetrate into the tissues beyond the apex of the tooth and destroy the bone. Several investigators claim that many chronic abscesses at the root end of treated teeth so often seen in x-ray films, may be attributed to the degenerative effect of arsenic on the apical tissues. Unless hermetically sealed, the drug will often leak out on the surrounding gum, and cause serious tissue destruction. Severe toothache lasting twenty-four hours or more often follows the placing of arsenic in a cavity. Patients may suffer terrible agony before the pulp dies and the pain finally stops. Yet, this drug remained the most valuable agent for the

killing of pulps for a long time, and Dr. Spooner should be included on the list of those who have helped to control pain.

Now by local injection, the pulp can be removed without the least pain. The use of arsenic has been practically discontinued. Procaine (novocaine) had done for dentistry what ether and chloroform have done for general surgery.

CHAPTER XXII

FALSE TEETH FOR THE MILLIONS

In 1772, Joseph Priestley, famous English chemist, discovered laughing gas. Five years later he wrote, "I have recently seen a substance, excellently adapted for the purpose of wiping from paper the marks of black lead pencil. It must, therefore, be of singular use to those who practice drawing." Incidentally, this very insignificant use, the rubbing out of pencil marks, is responsible for the name "rubber" in all English speaking countries. Among other peoples it is commonly called "gum caoutchouc," which in the language of the South American Indians, means the "tree that weeps." Rubber trees were indigenous to the Amazon River jungle and the natives obtained the gum by cutting the bark similarly to the method we use in tapping for turpentine.

There is no connection, of course, between Priestley's discovery of nitrous oxide, or laughing gas, and his interest in rubber, except that the use of rubber by the dental profession was spurred on by the introduction of gas which he invented for the painless extraction of teeth.

The elimination of pain from this usually dreaded operation changed the attitude of the public toward extraction. Patients, who in the past preferred to suffer toothache rather than go to a dentist, now were glad to take a few whiffs of the wonderful gas to obtain permanent relief. The removal of teeth had become a simple operation which most sensible people ceased to fear.

This influx of patients into dentists' offices created an unexpected problem. People of all classes began to demand full and partial dentures to fill the vacancies caused in their mouths by the removal of their decayed teeth. But, although porcelain imitations of human teeth had become rather cheap, assembling of the teeth into wearable appliances remained a complicated and expensive process. The plates upon which the teeth were fastened had to be made of gold or silver, swedged upon metal reproductions

of the patients' jaws, a tedious, time-consuming and intricate operation. None but the rich, or at least the well-to-do, could pay the price for the time and materials.

If the dental profession was to serve not only the rich but the public in general, the cost of false teeth must be greatly reduced. A cheap substitute for the expensive metals was definitely needed. Dentists everywhere began to experiment with different types of materials suitable for that purpose. But the results were discouraging. Every attempt and experiment ended in absolute failure. Then, quite suddenly, the difficulty was solved through the invention of the rubber vulcanization process. This discovery had nothing to do with dentistry but its influence on dental practice was incalculable.

Rubber had been known to the Western World for over three hundred years before its wonderful possibilities were realized. Back in the early sixteenth century several Spanish explorers, in the region now called Brazil, found the Indians making shoes and hats from a native gum that was water-proof. But the Spanish were seeking gold. The water-resisting gum did not interest them. Today, we can readily imagine a world without gold but not without rubber. Many of us may go through life and never have occasion to handle gold but no civilized person is ever out of sight or touch of rubber.

Even in Priestley's days, in 1772, over one hundred and fifty years after its discovery, rubber was scarce and almost unknown. An eraser, half an inch square, sold for about three shillings. At this rate a set of automobile tires would have cost about three thousand dollars.

Real interest in rubber did not begin until the nineteenth century, when a number of men started experimenting with rubber for various purposes. A Scotchman, Macintosh, who left his name in our vocabulary, was the first to attempt the manufacture of raincoats by dissolving rubber in coal-tar and spreading it on cloth. In some regions a raincoat is still called a "Mackintosh." The difficulty which baffled all experimenters, however, was the peculiar sensitivity of rubber to changes in temperature. In cool weather it stiffens and becomes brittle to the breaking point. In hot weather it softens and almosts melts.

About 1830, Charles Goodyear, a Yankee hardware merchant, began a series of experiments on rubber. All ended in failure, until, one day, quite accidentally, he found the secret of vulcanization which made rubber one of the most useful products of our civilization. A piece of rubber that he had mixed with sulphur fell into a hot stove. Goodyear picked it up

carelessly and was about to throw it away. He stopped short. A very strange thing happened. Instead of melting, this rubber-sulphur mixture had become hard and somewhat charred with the heat. Was it possible that sulphur and heat combined conferred on rubber that permanency that he and others had been looking for for so many years?

Goodyear could hardly believe his luck. He had so often been disappointed. Anxiously, he mixed up a batch of rubber and sulphur, held it over the stove for a time, and then nailed a piece of it on the outside of the storm door. It was a cold night and if the rubber did not turn hard and brittle after several hours of exposure to the frost, his search was ended. He could not sleep; he waited nervously for dawn. Upon examining the rubber, he found that it was unaffected by the cold. It remained soft and pliable. At last his poverty and privations were over. The goddess of chance had rewarded his years of patience and perseverance.

The entire rubber industry is founded on the Goodyear process; on his discovery that sulphur and heat make rubber stable under varying ranges of temperature. Hard rubber requires a larger amount of sulphur and heat for vulcanization. The Goodyear patent on hard rubber is dated 1851. Shortly after that "vulcanite," as he called it, was in general use for the making of dental plates and it has remained the most widely preferred material for that purpose all over the world.

At last the dental profession had the substitute for which it had been searching. Not only was rubber inexpensive, but what was more important, the turning of rubber into vulcanite plates required neither unusual skill nor costly apparatus. Almost anybody could learn to make rubber plates in a few weeks. It was, therefore, no longer necessary for the dentist to devote his own time to it. He did not have to make the entire set of teeth himself. He could now relegate part of the work, vulcanization, to a mechanic whose time was far less valuable.

Soon dental laboratories were established in all of the large cities. Dental plates, either full or partial sets, were within reach of the average man or woman at last. False teeth ceased to be a luxury of the rich. Poor people need no longer look forward to the unpleasant prospect of a "toothless" old age.

The early laboratories confined themselves to vulcanization only. Later they began to run up models and set up teeth for "try-ins." When crown and bridge work started to develop many laboratories added gold departments. But the better dentist would not patronize them and those who did were looked upon with derision. This attitude was partly due to the crude-

ness of the work done by most of the laboratories. But a more important reason was the stress which the profession as a group placed upon the technical side of dentistry. Any one who was not an expert at soldering a bridge or swedging a crown was considered an incompetent dentist.

This attitude however did not interfere with the phenomenal growth of dental laboratories in the United States. Because, in spite of criticism, their assistance became invaluable to the dental profession. The majority of dentists, whose practices did not warrant the employment of a laboratory technician, found that they could earn more money at the chair than at the laboratory bench. Sending the mechanical work to a commercial laboratory, besides increasing his income, relieved the dentist of spending many hours in his office which could be used to better advantage in meeting friends or acquaintances, thus building his practice. It also gave him more time for recreation and lightened his daily task.

Figures recently published show that in 1890 there were only two dental laboratories in the United States. In the next decade they increased to fourteen and by 1925 their number was two hundred and fifty. During the next four years they multiplied over ten-fold. At the peak of prosperity in 1929 there were more than three thousand laboratories in the United States doing an annual business of about fifty million dollars. The depression eliminated some of them, but even so there are more than two thousand laboratories today engaged jointly with the profession in furnishing dental services to our population.

The existence of such a large and economically influential group has, of course, developed a number of serious problems. For example there is the question of organizing the technicians into a union. Like other mechanics, they feel that to be necessary for their protection. Dentists object, fearing a rise in laboratory prices will force an increase in fees for dental services, working a hardship on poorer patients.

A more important problem is the pressure for state licensing of technicians. Like plumbers, barbers and other groups indirectly related to public health, technicians insist that they, too, should receive such protection. This of course opens up the possibility of many abuses. Once having been granted the privilege of a state license, it may not be long before technicians will be able to convince our legislators that an impression of an edentulous mouth is no different from an impression of a foot made by a shoemaker for the correction of broken arches. Licensed technicians may then acquire the right to make mechanical restorations directly for the patient. However, all progress brings its problems.

CHAPTER XXIII

PROCESS PATENTS BEGIN TO HARASS THE DENTAL PROFESSION

Process patents are granted by our government as a reward to inventors on the same basis as patents on machines. New processes, like new machines, have been of immense value to industrial progress. We need go no further than the rubber industry which is built entirely on the Goodyear invention. When such patents are valid and the process is economically advantageous, manufacturers are quite willing to pay the inventor a share of the profits for the right to use his method. Whatever conditions or restrictions the patentee may establish under his monopoly will seldom hurt the industry or cause hardship to the consumer of the product. Usually inventor, manufacturer and public all benefit from a new discovery.

But conditions in the healing professions are different. A patent upon a method of treatment or operative procedure is bound to lessen the effectiveness of the physician or the dentist. If professional men are tempted to withhold new discoveries in the hope of collecting royalties from their colleagues, the free interchange of information would halt. Clinics, lectures and discussions which form such a large part of professional activities would cease. Medical and dental practice would become commercialized and the results would be detrimental to the public health.

The introduction of vulcanite gave great impetus to dental progress but it brought in its train an evil which was destined to plague the dentists of this country for nearly three-quarters of a century.

Rubber vulcanization was patented in 1851. Soon after the discovery, a number of dentists attempted to use hard rubber in the making of dentures. It is claimed that Thomas W. Evans, famous Parisian dentist, made several sets of dentures for Goodyear, and at one time had demonstrated his method to Charles Goodyear, Jr. Dr. Evans, with his high professional

idealism, refused to patent the process. But Charles Goodyear, as a business man, had no such scruples and in 1855 obtained a patent on a mold and other steps in the use of vulcanite for dental plates. About the same time Dr. A. J. Cummings applied for a similar patent, which was allowed in 1864. This resulted in extensive litigation for priority with the dental profession in the middle between the two contestants.

The profession, of course, attempted to defend itself by organizing a number of protective organizations, amongst them were the United States Dental Protective Union of Boston, New York Dental Protective Union and the American Dental Protective Society. But the results of their efforts were negligible. After Goodyear and Cummings came to terms and pooled their interests, the dentists of the country remained entirely at their mercy.

About 1868, the control of vulcanite patents fell into the hands of Josiah Bacon who became the Nemesis of the dental profession in the United States. Shortly after his election as treasurer of the company, Bacon instituted a system of office license by which dentists were granted permission to use the vulcanite process in the making of artificial dentures. These licenses covered not only the vulcanization but also the various steps of impression taking, the making of models and the setting of teeth which had long been in common use. The fees ranged from twenty-five to fifty dollars per annum plus one dollar for dentures containing less than five teeth and two fifty for dentures of six or more. Altogether, it is believed that about five thousand dentists accepted Bacon's terms. The majority, however, demured, others tried to avoid payment of royalties by concealment; many substituted celluloid; a few gave up the use of vulcanite altogether.

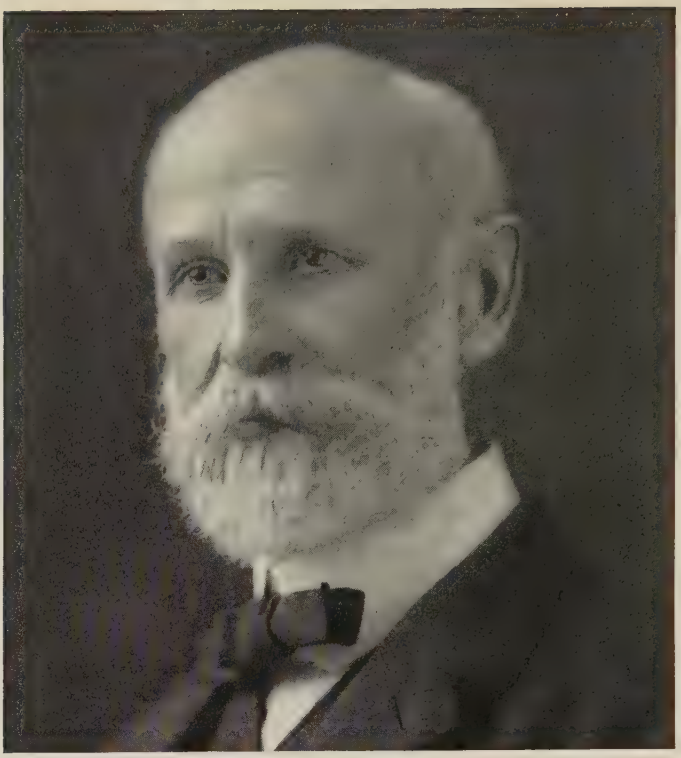
But Bacon was not to be thwarted. He was determined to stop the unlicensed use of vulcanite and soon his agents and spies were traveling all over the United States enforcing his patent claims by intimidation, lawsuits, fines, and other means of coercion. This situation continued for about eleven years, until April 13, 1879, when Josiah Bacon was killed in a hotel in San Francisco by an irate dentist, Dr. Samuel P. Chalfont, whom Bacon had prosecuted for infringement.

Chalfont was previously enjoined from using the vulcanite process by the federal courts at Wilmington, Delaware. This time Bacon was determined to make an example of him. During the trial Bacon was particularly ruthless in the cross-examination and Chalfont, an extremely nervous person, became very much agitated, losing control of himself on several occasions. It was in this state of mind that Chalfont later came to Bacon's room

DR. ROBERT ARTHUR

Robert Arthur, M.D., D.D.S. (1819-1880), was born in Calverton, Maryland, July 22, 1819. After receiving a splendid classical education, Dr. Arthur's acquaintance and contact with Chapin A. Harris in Baltimore led him into the study of dentistry, and he became the first graduate of the first school founded by Hayden and Harris in 1840, receiving his degree of Doctor of Dental Surgery in 1841. After practising for a few years in Baltimore, he removed to Philadelphia in 1846. He soon became prominent as a practitioner in Philadelphia and was one of the founders of the Pennsylvania College of Dental Surgery and its first Dean.

Dr. Arthur was nationally known as a most skillful operator and is credited with having discovered the cohesive qualities of gold in its application to gold filling for operations in dentistry. He contributed to the literature of dentistry, particularly the operative aspect, throughout his professional career. He influenced very greatly dental literature, and his teachings played a most important part in determining the character of the practice of dentistry during his time. He was a bold and fearless writer, an expert operator to whom the introduction of the cohesive gold filling will remain an enduring monument in dentistry.



DR. G. V. BLACK

Greene Vardiman Black, M.D., D.D.S., Sc.D., LL.D. (1836-1915), was born at Winchester, Illinois, in 1836. Dr. Black received his instruction in dentistry under a preceptor and began practice when he was twenty-one years of age. He located in Jacksonville, Illinois, in 1864, where he began experimental work in several phases of dental procedure and to play a most important part in its development into a science. Paradoxical as it may seem, the man whose work and studies were to influence, more than those of any other one individual, the trend of dental education did not have the advantage of a systematized preparatory education. His work in Jacksonville attracted so much attention in educational circles that in 1883 he was induced to remove to Chicago and accept the Professorship of Pathology in the Chicago College of Dental Surgery. In 1891 he transferred his activities to the Northwestern University Dental School, where he became Professor of Operative Dentistry and Dental Pathology, being made Dean in 1897.

Pioneering from the very beginning of his researches, Dr. Black was compelled to design and make with his own hands all of the machines and instruments he used for his experimental work, and examination of many of the machines and instruments he made and used readily reveals the mechanical genius that he was. In whatever phase of dentistry one may examine, will be found the works of the hand and brain of this man, who did more to standardize operative procedures than was done before or has been done since. It was he who conceived and applied the thought of technic work in the dental course of study; he standardized cavity preparation; he standardized amalgam manufacture; he laid the foundation for the standardization of dental terms; he standardized cavity nomenclature, and gave to the profession the first authoritative work on dental anatomy, and in countless ways contributed notably to the advancement of every phase of dental practice. He has rightfully been designated as "the grand old man of dentistry," and the profession has magnificently shown its appreciation of his work by every honor that it could bestow upon him.

at the hotel, trying to arrange some kind of a settlement which culminated in the murder.

At first the police were rather puzzled. The fact that no valuables were taken, seemed to indicate another motive than robbery. Upon checking Bacon's history and his movements prior to his death, it was found that he had many enemies among the dentists of San Francisco, whom he had been causing a great deal of trouble. Several had even threatened him with violence.

These facts gave the police their first clue which finally fastened suspicion upon Chalfont, who besides the Wilmington case had also been in trouble with the Goodyear Vulcanite Co. in Philadelphia and St. Louis. Several days after the shooting Chalfont surrendered to the police. According to his story Bacon had been uncompromising in his attitude and threatened to ruin him or even put him in jail. He said that he had only pointed his gun at Bacon with the idea of intimidating him into granting his demand. But in the excitement the pistol discharged accidentally, and the bullet lodged in Bacon's abdomen. Horrified at what had happened, Chalfont immediately went to the police station but no one was in the chief's office at the time since it was a Sunday. Feeling very ill, he went up to a room and remained there until the day of his surrender, April 16, without knowing that the police had been looking for him.

Both the police and the public in general were inclined to believe Chalfont's story, since he was a man of excellent character and good reputation. Most people felt that he had been persecuted by Bacon and sympathized with him. The dental profession looked upon him as a martyr and many dentists from all over the United States contributed funds for his defense. The jury took into consideration the extenuating circumstances of the case and Chalfont was convicted of second degree murder and was sentenced to serve ten years at San Quentin prison.

Three years after his incarceration Chalfont escaped from confinement but was later recaptured and served out his full term.

The Bacon episode put a stop to the general persecution of the dental profession for infringement and after the lapse of the patents in 1881 dentists were free to use rubber in the making of plates without fear of being hailed into court by some exploiter of process patents. Royalties and license fees which the dentists of this country had paid at the time of Bacon's death amounted to over three million dollars.

It was the vulcanite patent situation that caused the popularity of celluloid as a denture material. Introduced in 1869 by the Hyatts, father

and son, the new material was accepted enthusiastically by a number of dentists all over the United States. It offered freedom from the annoyance of the process patents and was much superior to pink rubber in appearance. But enthusiasm soon waned; the color did not stand up. In many mouths it turned an ugly green. But even worse, the bad odor and the unpleasant taste were very annoying to the patient.

Rubber, of course, is far from an ideal product for dental purposes. It is porous, therefore hard to keep clean. Some people's oral tissues do not react well to rubber or the sulphur which is mixed with it. The lack of thermal response is still another of its several disadvantages. To overcome some of these, dentists began to combine gold bases with vulcanite for tooth attachments. There are records of patents covering this type of denture construction dated 1864.

But the gold plate was too expensive for the majority of patients. Accordingly, some attempts were made to substitute swedged aluminum. These attempts, however, were unsuccessful, because there was no aluminum solder with which to fasten the attachments that would hold the vulcanite in place. Therefore, in spite of its many faults, rubber (pink and maroon usually) was used in about 95% of all dentures made in the United States or anywhere else.

About 1890, Hollingsworth introduced a method for casting aluminum bases. These, combined with vulcanite, enjoyed rather wide popularity. Indeed, the only objection to this type of denture was that some patients complained about the metallic taste.

The Taggart technique made it possible to obtain denture bases that had better adaptation to the tissues than could possibly be made by any other method.

The condensites, introduced about 1924, were largely the result of the search for a material which would look more like the natural gum tissues, than the opaque pink rubber. At the beginning the colors were not permanent, after this difficulty was finally overcome the use of condensites was still limited because of their inadequate strength and difficulty of repair. More recently, however, these materials have been improved and the condensites are rapidly replacing vulcanites in most offices.

Lately a base made of pink porcelain has been developed, while still in the experimental stage, it nevertheless seems to offer a great deal of promise and when perfected the dental profession will have realized its age-old dream—an inexpensive all porcelain denture, the dream which originated with the French apothecary M. DeChateau in 1774.

CHAPTER XXIV

THE DEVELOPMENT OF AMALGAM FILLINGS

There is no record of when or by whom teeth were first filled, but it is not unreasonable to assume that any savage would plug up a hole in his tooth with whatever material he had available for the purpose. In most instances, some product of the field or forest; possibly a wax or a gum exudate from the trees near his cave.

The Romans used lint, tightly packed in hollows of frail teeth as a filling to facilitate extraction without breaking. Various gums were employed in Europe and in Asia Minor by the Arabians throughout the Middle Ages. The barber-surgeons of that period were also familiar with a kind of cement which was, however, more akin to mortar and readily soluble. All these were, of course, temporary and of little value. Such fillings would fall out in a few days or weeks.

About the time of Fauchard, or a half century earlier, French dentists began experimenting with metals. The common method was to roll small cylinders out of lead, gold or tin-foil, place the cylinder in the cavity and condense them with pluggers and mallets. These fillings were an improvement on the gum or mortar, but were still impermanent. Dentists did not possess the knowledge or the instruments to make the sheets of metal adhere to each other and to the cavity wall. Most of these metal plugs leaked and the seepage of saliva caused a recurrence of decay within a short time and the fillings would drop out.

Failing to obtain satisfactory results with foils of metal, the dentist tried amalgam. Scientifically, the term amalgam means a combination of one or more metals with mercury. The different metal-mercury combinations probably originated in shops of those pseudo-scientists, the alchemists. During the Middle Ages many alchemists believed that, given the right formula, one would acquire the touch of Midas and turn base metals into

gold. They were very much fascinated by that shiny grey liquid, mercury, which could dissolve other metals so readily, and it frequently formed the starting point of many of their experiments. Of course, not one of them realized his ambition to produce the coveted gold, and some even forfeited their lives for disappointing the avarice of kings or nobles, but the information which they left behind served as a basis for our present knowledge of amalgams.

The first definite information about the use of amalgam as a filling material dates from about 1826. A certain M. Taveau of Paris began using what he called "silver paste," a combination of silver filings and mercury. Convenience probably suggested the use of the filings of silver coins, which meant the inclusion of copper into the amalgam because usually the coins contained a small quantity of copper. But this amalgam soon proved even less desirable than the metal foils because of its peculiar behavior when passing from the plastic to the rigid state. Silver, when mixed with mercury, expands after setting and it was not a rare experience for a patient to return in a few days with a fractured tooth or the fillings protruding above the cavity and interfering with the closing of the jaw. Most dentists, therefore, discontinued the use of amalgam and went back to foil cylinders, gums and even soluble cements, which in spite of their poor qualities, were preferable to the "silver paste."

But amalgam possessed too many advantages of manipulation to be lightly disregarded and under ordinary circumstances dentists undoubtedly would have continued experimenting with it and the undesirable properties eliminated in time. Unfortunately, an incident occurred which turned the profession of this country entirely against the use of amalgam, stopped all experiments and retarded the introduction of this very fine tooth saving material for several decades.

In 1833, two adventurers, the Crawcour Brothers, without skill or experience, and without claim to the title of dentist, suddenly appeared in New York City and began dental practice amid a shower of advertisement and a flare of publicity that shocked the staid and dignified dental profession. Even had the Crawcours started practice in the ordinary manner and with common materials, there is a little doubt that such unprecedented methods of publicity would have aroused the opposition of all respectable practitioners. But when, to their flagrant and bizarre advertising, was added the enormity of introducing an unsatisfactory filling material, the exasperation of the better class of dentists was raised to the highest pitch. There is no question that the better element in the profession felt it to be its duty to

protect the public from the foreign "charlatans." Nevertheless, had the practice of the Crawcours been small, there is reason to believe that their opponents would have contented themselves with simply condemning the efforts of the two adventurers. But the office of the Crawcours was thronged with the best patients of the foremost dentists. The gold plugs of Baker, Greenwood, and others were suddenly no longer in demand. The Crawcour Brothers were replacing them with the "Royal Mineral Succedaneum." This long name in plain English meant nothing more than a substitute for the royal mineral—gold, and the substitute was nothing more than an amalgam of silver and mercury. The public however was not concerned with the name. "Royal Mineral Succedaneum" fillings were less expensive and much easier on the nerves, than the painful operation incidental to foil fillings. This keen competition added a personal interest to the dictates of virtue. Besides being quacks, the Crawcours were also ruthless competitors; enemies who must be fought with all available means. A relentless crusade was begun, therefore, against the foreign rivals. Amalgam was denounced not only as a poor filling material but also as the cause of mercurial poisoning, diseases of the gums, and a number of other ills disastrous in their effects. The onslaught was so powerful that the Crawcours were finally compelled to retire in defeat.

This particular phase in dental history is often referred to as the "Amalgam War." The attitude of the New York dentists soon spread to the rest of the country. By the time the Crawcours left, most of the dentists had forgotten the major cause of their violent opposition to amalgam as a filling material. The objection had become a matter of principle, and principles are often nothing more than unreasoned prejudices.

"The amalgam war" raged within the dental profession for nearly two decades. Leaders everywhere were vigorously opposed to amalgam. Organized dentistry disowned, denounced, ridiculed the "nasty stuff." Resolutions were passed protesting its employment under any circumstances in dental practice. Members were obliged to sign pledges, promising not to use amalgam upon threat of expulsion from the society.

In August 1845, the following resolution was passed unanimously by the Mississippi Valley Association of Dental Surgeons:

> "Resolved, that we consider the use of all mineral paste in the plugging of teeth, as unprofessional and highly injurious, and that we will neither use it, nor countenance its use by others."

Shortly after that the dentists of New York also passed a resolution that:

> "Any member of this Society who shall hereafter refuse to sign a

certificate pledging himself not to use any amalgam, and moreover, protesting against its use, under any circumstances, in dental practice, shall be expelled from the Society."

An amendment also provided that the recording secretary should notify all members of these resolutions and forward a printed pledge or certificate to each as provided for in the committee's report, to be signed and returned within sixty days of the date of its issue, under penalty of the recipients being dropped from the rolls. In 1848, eleven members were suspended from the Society in New York for malpractice—for using amalgam!

But there was a sizable minority, particularly practitioners working for the poorer people, that paid no attention to the resolution. Amalgam was an unsatisfactory material but it was better than anything else which they could use for the fees they were able to collect. Their patients could not afford gold foil fillings. Moreover, a number of prominent men resented the autocratic attitude assumed by the dental societies. These men agreed that amalgam was not a proper material to use in the mouth, but they refused to admit that any dental organization had the right to demand pledges from its members, or to suspend those who refused to sign such pledges. These bickerings and controversies continued until 1855, when most of the resolutions were finally withdrawn. But, though the opposition to amalgam was at an end officially, the acrimony and bitterness remained and the fight continued with unabated vigor for many years. The character of the antagonism may be inferred from a statement made by one of the most prominent dentists of the time, "I have neither used nor experimented with it in any way. I would not touch the nasty stuff." Incidentally, this controversy broke up the American Society of Dental Surgeons founded by Hayden and Harris.

It was not until the older men who had participated in the fight had died or retired from practice that dentists found the courage to begin experiments and develop new formulas which resulted in the perfection of amalgam. Gradually, it became recognized as an extremely valuable filling material for the posterior teeth. These new experiments started about the middle sixties. Several investigators found that amalgam of tin filings and mercury behaved in just the opposite manner to silver. That is, instead of expanding, it would shrink. Accordingly, they began developing a formula containing a combination of the two metals, balancing the expansion of one with the contraction of the other. These combinations were an improvement over the silver coin fillings but as yet far from satisfactory. In the later 1870's came the first organized movement on behalf of amalgam under the

leadership of Dr. J. Foster Flagg. This movement, sponsored by several outstanding men in the profession, became known as the "new departure," notable for its creed that amalgam was a valuable filling material and that reports of its being injurious to the health of the patient were unfounded and untrue. Flagg did considerable work in this field but his experiments were inconclusive. For several years the dental profession remained in doubt as to the advisability of using amalgam for filling teeth. Then in 1895 G. V. Black began his memorable investigation.

Black, next to Fauchard, is probably the best known name in the annals of dentistry. Born in Jacksonville, Illinois, he spent most of his active years in Chicago as a teacher and lecturer. Dr. Black probably contributed more to the progress of dentistry than any other single individual. There is hardly a phase of dental practice which did not benefit from his genius and his influence. When he died (about 1910) the grateful dental profession erected a monument in his honor at the entrance to one of the Chicago parks.

Many of the methods which he originated and taught to his students at Northwestern University Dental School a number of years ago are still practiced, with little change, today. The most notable of Dr. Black's achievements and one for which he will perhaps be remembered the longest was the perfection of dental amalgam.

CHAPTER XXV

THE PERFECTION OF AMALGAM

Black possessed the one characteristic common to all superior men of science. He was a keen observer. Dentists had always looked at teeth, but Black was the first to actually *see* them. After repeated inspection of extracted teeth filled by dentists who tried to keep their fillings as small as possible, he found a very high percentage of failures due to the recurrence of decay at the margins of these fillings. Continuing his studies, he noticed that while all teeth were apt to decay, the susceptibility of the different surfaces on each tooth seemed to vary in proportion to their being self cleansing. As a result, he came to the conclusion that if cavities were cut larger and the margins brought into the more immune areas, most fillings would last longer. After testing this theory and checking his observations, Black finally developed his famous method of cavity preparation, founded on the principle of "extension for prevention"; that is, extension of cavities beyond the areas of susceptibility into areas of comparative immunity, where experience showed decay was less likely to recur.

At the beginning, since the extra cutting of good tooth structure for the purpose of "prevention" was contrary to the habit of the profession, it brought forth some resistance to Black's teachings. But as time went on and more men adopted his method, the evidence in favor of Black's theory became overwhelming, and soon was accepted by the profession in this country and in other parts of the world.

But the new types of cavities required fillings of larger surface area. This, in turn, necessitated materials of greater edge strength since, as surface area increases, the stress caused by biting and chewing become greater. Black undoubtedly realized this. His keen interest in amalgam probably developed as a result of his search for a strong and inexpensive filling

material, for he must have realized that without such a material "extension for prevention" must perforce have remained of very limited practical application.

Toward the close of the nineteenth century, amalgam had become fairly popular. Most dentists were using it because it was inexpensive and easy to handle. Every manufacturer of amalgam alloys had his own special formula for which he made particular claims of superiority. But actually all were equally unsatisfactory. A dentist never knew when a patient might return with amalgam fillings cracked, chipped or perhaps out altogether. He wasn't even sure that each batch made by the same manufacturer would give him the same results. The entire process of alloy making was empirical and unscientific.

Black approached the problem in the manner of the trained research worker. First he wanted to know just what the requirements were; how much force was exerted by the lower jaw upon the upper jaw when the teeth were brought into occlusion; what was the stress of mastication while chewing various foods such as steaks, fibrous vegetables or bread. To answer his questions Black invented an instrument which he called a "Gnathodynamometer." In plain English that was a device for measuring the chewing force. No one had realized how powerful the human jaws were nor how much pressure they could exert. Black's device showed that one hundred to one hundred and seventy-five pounds pressure was normal and that some people exert a force as high as three hundred and twenty-five pounds. No wonder such people can crack hickory nuts with their molars!

Other instruments which Black invented indicated that most of our foods required but a fifth of the available chewing force. That is why sound teeth are seldom broken or cracked during mastication. There is a 500% to 600% margin of safety. This explains how two teeth used as abutments are able to carry three or four artificial substitutes, performing the work of five or six. It would seem that Nature had foreseen and provided for our dental infirmities.

We shall not attempt to describe the many experiments and the ingenious precision instruments which Black made or invented. That would lead us into rather complicated technical detail, which may not be particularly interesting.

Black continued his intensive research for several years until, finally, he was able to give to the profession an amalgam filling that met all the requirements. It neither expanded nor contracted, and its hardness was sufficient to withstand the masticatory force required by the normal diet.

Within a short time after his findings were published, Black's formula and his method of alloy preparation became the standard wherever amalgam was used.

Except for the fact that the silver tarnished and the color was unsightly, amalgam was considered a nearly ideal filling material. Then, suddenly, dentists began to complain that while alloys worked perfectly when fresh, after standing in their cabinets for some time such alloys would become "wild" and cease to behave properly. Hardening time slowed down and fillings became unsatisfactory. Here indeed, was an interesting phenomenon; metal fillings suffering from old age! But all tests seemed to confirm the complaints. Black returned to his experiments. He searched, tested and checked. He found that the time element was not a serious factor, for alloys made according to the same formula under the same conditions, had a variable spoiling age, ranging from a few weeks to several months. This discovery, however, did not bring him any nearer to the solution of the problem. No matter what he did, alloys continued to become "wild" and to deteriorate.

Black was puzzled until, one day, he accidentally stumbled upon a clue which finally solved the problem. He had been working in his laboratory at the Northwestern University Dental School. Prior to housing the school this building had been occupied by the Tremont Hotel, a famous hostelry, landmark in Chicago. For some reason, when the building was remodeled, this particular room remained stove-heated and the stove stood rather close to a wall along which were several shelves. On one of these just about parallel with the center of the hot stove, Black stacked a row of glass bottles, containing some old amalgam alloys, which he thought were spoiled. Each bottle bore the date of manufacture, the formula and other important data. That afternoon, while pouring some of the filings into a mortar to mix with mercury for the purpose of making comparative test fillings, Black noticed that the bottles were warm, almost hot. That was due, of course, to the proximity of the hot stove. Imagine his surprise when several days later, his precision instruments revealed those fillings to be nearly perfect, just as if made from fresh alloys!

Black then recalled how hot those bottles felt to his touch and it occurred to him that the heat might have corrected some of the faults which were attributed to aging. It was a hunch worth considering. The details of his experiment are not important, but the hunch was right. By repeating his tests, again and again, he was able to prove that alloy fillings heated to a certain temperature would remain stable for a reasonably long time. Heat-

ing or annealing, as it is commonly called, took the "wildness" out of alloys and kept them on their good behavior.

Black's discovery, like Goodyear's in the rubber field, was accidental, though that term is incorrect, really. When we are searching diligently for something and find it in a different place from where we expected it to be, that cannot be considered an accident. Both of these men had been working for a long time conducting all kinds of experiments. When they picked up helpful clues, that was a bit of luck, of course, but hardly an accident. All success in life consists of "breaks" but we have to be in a particular spot at the right moment and we must possess the right judgment and the ability to take advantage of the "breaks," and turn them to our best advantage. In Black's case, the lucky break was a big roaring fire burning one afternoon in a barrel shaped stove. In Goodyear's case, it was a piece of rubber and sulphur that was accidentally exposed to heat.

Recently the United States Bureau of Standards has done some work on dental amalgam and developed a few refinements in the manufacturing of alloys. The formulas, however, have remained very much as Black left them more than thirty years ago. The expansion of silver and the contraction of tin which takes place when the metals are mixed with mercury separately have been balanced in the proportion of about two-thirds of silver to one-third of tin. To this stable combination has been added a small quantity of copper and a lesser amount of zinc. The metals in their purest state are melted together to form a solid block which is then placed in a special machine and turned into fine filings. To prevent spoilage the filings are heated to a specific degree of temperature for a certain length of time.

But good alloys do not necessarily make good fillings. Perfect results depend upon a strict adherence to the details of manipulation, as worked out by Black and other scientific investigators. The whole process has been developed to such a high level of perfection that carefully made alloys properly handled will have a definite expansion of one ten-thousandth of an inch after the filling has set (hardened). This slight expansion insures against seepage of moisture, which is the prime essential in all fillings.

In recent years objection to amalgam appeared from a rather curious source. Some drugless healers who object to the use of drugs in any form and for any purpose in the human body, had been warning their patients against the ill effects of amalgam because such fillings contained the poisonous chemical, mercury. Their claim was that the patients might absorb some of the "poison" into their system. Knowing little about drugs and less about physics and chemistry, this objection on the part of these "doctors"

is not surprising. But of course they are wrong. The mercury in amalgam fillings does not evaporate and cannot possibly injure a person's health for the simple reason that there is no free mercury, as such, in amalgam.

The setting of amalgam is similar to the hardening of concrete. Anyone who has handled old concrete blocks knows that there is no free moisture in the concrete, though originally the cement was mixed with water. Mercury can be recovered from amalgam, but the heat required is far above that which the human mouth could possibly endure. No food or drink is ever that hot. If the mercury left the amalgam in the mouth, under normal conditions, the fillings would soon disintegrate and crumble away. This is contrary to general experience for amalgam fillings, as they have been known to last for decades. Ignorance is not so much the lack of knowledge but possession of information that is not true.

More recently there has been some discussion regarding the injurious effects that may be caused by the generation of electric current between gold and silver fillings in the presence of the saliva. So far, however, the evidence is not sufficient to justify any definite conclusion.

CHAPTER XXVI

GOLD, CEMENTS AND PORCELAIN FILLINGS

Josephine, the wife of Napoleon was supposed to have had badly decayed front teeth of which she was very sensitive. For this reason she always held a handkerchief in front of her mouth. The court ladies followed the example of the Empress and it is said that this was the origin of the fashion among women that has prevailed ever since; that of carrying handkerchiefs in their hands.

In the early nineteenth century neither empress nor char-woman could do anything about facial disfigurement caused by bad teeth. It was only after 1855 that the dental profession first learned to put gold fillings in the front teeth that could be expected to remain permanently. Today, we object to the display of gold when speaking or laughing. But the French empress, her friends and the several generations that followed, would have been very happy if their broken centrals could have been restored with gold.

In 1855, Dr. Robert Arthur who was one of the first two graduates at the Baltimore College of Dentistry, announced a method for the use of cohesive gold foil for filling purposes. With this form of gold it became possible to build full contour fillings in almost any cavity where adequate retention and dryness were obtainable. Dr. Arthur discovered that by passing gold foil over a hot flame it could be welded cold. Welding is the process of making the molecules of two pieces of metal flow together so intimately that no sign of a joint is left. In most metals the molecules seem to be rather inert, and reluctant to join their fellows. For example, iron can be welded only after exposure to an extremely high degree of heat. Even then, it must be coaxed with hammer and anvil before the two parts become one. But the gold atoms are evidently a more friendly lot and are quite ready to cohere providing no foreign matter comes between them. Ex-

posure to heat drives off the moisture and other impurities present in the air that might contaminate the gold and the clean metal can then be condensed into a solid mass with comparatively little pressure.

Although the profession soon recognized the great filling qualities of cohesive foil the method did not become popular for several years because it was very difficult to keep the field of operation dry and to prevent saliva from contaminating the gold, so that cohesion would not be lost. In 1864 Dr. Barnum, practicing at Monticello, New York, conceived the idea of using a rubber dam in dental operations. This simple contrivance made it possible to maintain perfect dryness and the insertion of cohesive foil fillings spread rapidly. Dr. Barnum could have made a great deal of money had he chosen to patent his process, but with true professional spirit, he donated his invention to the dental profession. His generosity was recognized by some members of the profession and he was voted medals and tokens of honor. Unfortunately, his example was not followed and the menace of process patents threatened the dental profession for more than a half century, after Barnum's great gift.

Gold foil fillings proved very satisfactory. When skillfully done, some of them served for a quarter of a century or more. The only drawback was that it required from one to several hour's time to complete a single filling. Three hours in the chair at one sitting with the rubber dam over the patient's mouth was not unusual. Older dentists will recall the many long hours spent condensing gold; hours that taxed both patience and endurance. Today the inlay has practically displaced the old type of gold filling for most people prefer the less exhausting, even though perhaps less durable, operation. Long sessions in the dental chair like long Sunday sermons have passed out of our lives, we hope never to return. This opinion is not unanimously shared. A small minority still insist in singing the praise of the mallet foil fillings, but it is like a voice in the wilderness. Most students throw away their condensing pluggers after graduation.

Dental cement also came into existence about the same time. The first was the oxychloride of zinc (1860). Later it was changed to oxyphosphate because of its superior adhesive properties. Nearly every dental appliance, whether fixed or removable, is either assembled or fastened with cement. Dentistry as we know it today would be practically impossible without this material. For years cement fillings remained the only alternative to gold foil. Whenever a patient could afford the fee or his health would not permit a long sitting in the dental chair the dentist would resort to cement. But results were unsatisfactory. Cements are comparatively soluble and do

not possess the necessary edge strength to withstand the stress of mastication. When amalgam was finally perfected the dental profession stopped using cement for fillings, excepting in children's teeth or for other temporary operations.

The strong adhesive quality of cement suggested the possibility of eliminating the flashy yellow gold from front teeth through the use of porcelain inlays. Sensitive people had always objected to this kind of facial decoration. The inlaying of wood and metals was an ancient art and there seemed to be no reason why the dentist could not imitate the jeweler, or other craftsman, by inlaying the teeth with small flakes of porcelain matching the natural color and held in place with cement. Some experiments with this method began about 1858 but were soon discarded as impractical, since it was seldom possible to grind a piece of porcelain sufficiently accurately, so that it would even come close to fitting the cavity.

Shortly after 1886 a number of dentists started experimenting with low-fusing baked porcelain inlays, formed to duplicate the shape of the required filling. This solved the problem of accurate adaptation. But there were other difficulties. The cement always left a visible line around the porcelain and made it look like a patch, even though the dentist might succeed in obtaining a good match with the natural tooth, which was extremely difficult in itself. Indeed, failure to obtain perfect blending with the tooth was very common. An even more serious drawback was the fact that while the color of the porcelain remained constant, the natural tooth became darker year by year with the advancing age of the patient, so that before long even the most perfect porcelain inlay ceased to match the tooth. Actually well polished gold fillings looked better than most porcelain inlays; therefore they continued to be the routine operation.

The inlaying of porcelain in teeth, though original with American dentists, was not a novel idea. Both in Mexico and in Peru numerous skulls have been found in which the front teeth carried small disks of gold, basalt or quartz. These inlays were apparently for decorative purposes only, since none of them has ever been found in the molars or bicuspids. There is no evidence that the American Indian knew anything about restorative dentistry. From all reports, such knowledge would perhaps have been superfluous because it seems that those people had unusually good teeth. This condition has been attributed by some to the chewing of coca leaves mixed with lime, a practice very common among the aborigines of South America to this day. A similar effect is obtained by the betel-nut chewers in other parts of the world.

The Mayans and Aztecs, although they had reached a fairly high stage of civilization when the Spaniards found them, had not yet acquired sufficient skill to smelt iron ore. Technically, South Americans were in the polished stone age. Iron was unknown on this continent until the arrival of the Europeans. The grinding of the cavities for those inlays must have been done with small stone points, a slow and tedious process. And, probably very painful. But that evidently did not stop them, as man has been ever ready to endure all kinds of torture to make himself beautiful. We do not have to go far afield for examples. Knocking out of teeth to enhance facial beauty is one of the commonest practices. Some tribes prefer to file their teeth into sharp points (usually the upper incisors) in order to make them look like ferocious lions or tigers. Many African peoples think that a moon shaped notch in the centrals and laterals adds to their attractiveness. Certain Malay groups amputate about half of the length of the front teeth, the stumps are then blackened with certain minerals and juice of herbs. This is done, because in the opinion of the natives, white teeth of natural size make them look like dogs. All these mutilations of course are painful, but we need not feel superior to the benighted savages. Some of our own women have their faces lifted. Even the plucking of the eyebrows is not entirely painless.

Synthetic porcelain or "enamel," as the public usually call it, is a European product introduced into the United States about twenty-five years ago. Either name is incorrect for "enamel" is nothing more than a silicate cement, except that it is translucent and therefore reflects light like the natural teeth. Like all cements, however, synthetic porcelain is brittle and chips very readily. Its usefulness is limited mostly to cavities in the front of the mouth where the fillings are not subject to the stress of mastication. Even so, the majority of dentists use synthetic enamel because it is easier to insert than gold foil and the public at large prefers it. The dental profession is still looking for a perfect filling; one that has the necessary strength and will match the natural color of the teeth.

CHAPTER XXVII

THE "DENTAL ENGINE" AND THE DEVELOPMENT OF CROWN AND BRIDGE WORK

Progress in the construction of fixed appliances did not keep pace with other branches of dental practice. Crowns and bridges and fillings continued to be done crudely and were short-lived. Indeed very few were better than those made by Fauchard a century earlier. Yet this can not be attributed to deficiency in materials, or manipulative skill, for suitable porcelain teeth were readily obtainable, and the dental profession had ample experience in the art of handling gold in its various forms.

It was not inadequacy of materials or of skill, but the lack of an efficient grinding machine that was responsible for the slow progress in this phase of dentistry. Good crowns can be fitted only to properly prepared roots. Fillings would not stay in unless cavities are cut along certain lines. But all these operations cannot be done with hand tools or even with bow drills, which some dentists attempted to use. Furthermore, there is always the possibility that the instrument may slip. What the profession needed was an efficient grinding tool that would be under the absolute control of the operator at all times.

A machine possessing these qualities was not available until about the middle of the nineteenth century. After the sewing machine was invented, in 1871, Dr. Morrison applied for a patent on a dental engine adopting some of the mechanical principles which had been developed by Singer and Wilson. This engine was run by the foot power of the operator, leaving both hands free; one to guide the instrument and the other to protect the tissues of the patient's mouth from accidental injury.

"The Drill," as patients call it, may not have many friends. It is undoubtedly responsible for keeping many people away from dental offices, for even when not painful the sensation of having one's teeth ground is

decidedly unpleasant. The inquisition would surely have welcomed such an instrument of torture. Yet without the dental engine or "drill" dentistry could never have made any progress. In recent years, the foot power machine has been replaced by electric motors, but the control is still on the floor and manipulated by the foot.

With the advent of the dental engine, crown and bridge work made rapid strides. This new and efficient grinding tool, combined with the inventive genius of some members of the profession, developed the art of replacing lost teeth by fixed appliances made of gold and porcelain, beyond anything that the dental profession had ever dreamed.

Dental engines ushered in what may be called "The Golden Age" of dentistry. The mouths of the people in the United States became decorated with gold crowns and gold bridges. Americans everywhere were recognized by their flashing golden smiles. In some sections of the South, gold teeth in the front of the mouth was considered an aid to facial beauty, like earrings and other decorative jewelry. Patients preferred gold crowns and fixed bridges to partial dentures. Fixed restorations were more comfortable. Besides, false teeth were associated in the minds of people with old age. And no one liked to be considered old.

In the making of these fine mechanical pieces, dentists made very effort to save every root and every snag which could be used to support fixed appliances. Pulps were indiscriminately removed from good sound teeth which were then ground down to meet the various requirements of fixed bridgework. This wholesale pulp destruction was in accord with accepted teaching in most dental colleges at the time. Middle aged dentists may still remember that, as students, they were warned by their professors in the prosthetics department never to crown a tooth without first removing the pulp and filling the root canal.

Frequently, treated roots would become abscessed and sore to the touch. They might discharge pus through the gums, but the dental profession paid slight attention to these conditions. After pain had been relieved by opening the abscess and allowing the pus to drain, the patient would be assured that such abscesses were entirely harmless and need cause no worry. That the roots of these teeth were imbedded in the jaw-bone and were connected directly with the blood stream and the nervous system escaped the attention of dentists, and of physicians as well. A doctor examining a patient would never fail to look at the tongue, since the appearance of that organ gives the physician important information about the

condition of the patient's health, but he was not interested in any other part of the oral cavity—in the teeth or in the gums.

From the present point of view, with our knowledge of the relationship which exists between infected teeth and various diseases, and considering the cause of rheumatism, arthritis, neuritis and other ailments that frequently result from focal infection around roots from which the pulps have been removed, it seems strange that both professions should have remained so long complacent toward these swellings and abscesses. It is hard to explain how, with their knowledge of physiology, anatomy and pathology, dentists and physicians could have overlooked the seriousness of oral infection.

Yet such occurrences are not unusual. History is full of incidents where man has gone on blundering for generations and centuries. Valuable facts thrown across his path remain unnoticed until discovered through sheer accident, or by the aid of some genius. When, finally, attention is called to these facts, everybody wonders why anything so self-evident and so simple should have remained unnoticed and unobserved.

An outstanding instance is the tardy recognition of the circulation of the blood. From the beginning of time man has been spilling the blood of both his fellowmen and the animals about him. And yet, nobody had recognized that the heart, lungs, arteries and veins are a central system, propelling the blood, which has been oxygenated by the lungs, through the arteries to every cell in the human body. This most important cycle, which is the basis of life, remained undiscovered until William Harvey called attention to it in 1651. Prior to Harvey's time the accepted teachings of the medical profession were that the body contained two circulations. One was through the arteries and the other through the veins. They thought that the circulation was not rhythmic and regular but slow and irregular like the flow of air in a house, and that the heart was merely a mixing chamber for the blood and the spirits, and not the muscular pump which is the center of the entire circulation. Our reaction to the shortcomings of mankind of course depends entirely upon our point of view; whether we prefer to look at the road ahead or at the substantial distance which humanity has already traveled.

For almost two decades, the dental profession was smugly satisfied to improve its mechanical skill and increase its income. Patients, too, were reasonably happy. They liked the fixed bridges which felt comfortable and as good as one's own teeth. The fame of American dentistry spread far and wide.

Occasionally some one would protest that "gum boils and abscesses which appeared so suddenly over the root ends of the teeth could not be entirely harmless"; that there must be some reason for the sudden appearance of those swellings about the face. As early as 1891 *Dental Cosmos* published Willoughby D. Miller's original communication entitled the "Human Mouth as a Focus of Infection," but very few paid any attention to his writings.

It is interesting that advertising dentists who did not care how their crowns fitted, and did not bother to remove the pulps from the teeth, actually caused less infection than those who practiced according to approved methods as taught in the dental schools. This, of course, does not entitle the charlatans to our respect. If they did less harm than the decent members of the profession, it was not because of a special concern for the patients welfare, but merely an accidental result of their dishonesty.

CHAPTER XXVIII

PROCESS PATENTS AGAIN PLAGUE THE PROFESSION

The Goodyear and Cummings patent expired in 1884. At last, after more than three decades, the vulcanite process became public property and it was no longer necessary to pay royalties on the use of rubber to make dentures. The profession was finally freed from the annoyance of patent owners, their attorneys and their spies. But that freedom was short-lived. The vulcanite crowd, which had found the dental profession a very lucrative source of income, was unwilling to lose that income. Accordingly, they began to look for new means whereby they might continue to enrich themselves through the labors of hard working dentists.

Their search was neither long nor difficult. Already a number of dentists of questionable ethics had obtained, or had applied for patents, on every minute step in the construction of crowns and bridges. The gold shell crown, patented by Beers in 1873, the Richmond crown patented by C. N. Richmond in 1880, and the owners of the patents covering porcelain facings in the construction of dental bridges, were among those who, without scruples, sold out to the International Tooth Crown Company. The organizers of this company were none other than the former exploiters of the vulcanite process, and within a short time they had obtained title to over twenty-five patents covering every step in the making of crowns and bridges so that it became impossible to practice dentistry without infringing on some of their claims.

The validity of those patents was extremely doubtful. Some of the claims were old and could be found in the prior art; others were not sufficiently important to deserve patent protection. But this did not discourage the International Tooth Crown Company organizers. They knew, of course, that no individual dentist could afford to pay the costs of litigation, and

they believed that since the profession was unorganized and without effective leadership it would be an easy matter to brow-beat most dentists into accepting licenses under their patents and paying them royalties.

Events later proved that the promoters had miscalculated. It was a mistake on their part to assume lack of leadership among the thousands of dentists practicing in the United States and to suppose that the profession was incapable of defending itself against exactions. At the beginning it seemed as though the plans of the International Tooth Crown Company would succeed. Their men traveled throughout the country, intimidating many dentists into buying rights to practice crown and bridge work under their patents at fees running from one to five hundred dollars per year.

After securing as many licensees as possible in a town, the agent would, by way of reward to his victims, insert this notice in the local papers:

DENTAL NOTICE

This is to certify that..... Office No. .....Street is our only licensee, to make and to furnish to patients in the city of..... any tooth crowns or bridgework, so called, manufactured under the patents of the International Tooth Crown. . . . Said patents are construed to cover the most practical forms of artificial dentures now commonly known as crown and bridge work.

All persons are hereby cautioned against obtaining any such artificial dentures from any dentist not licensed, as none are authorized except by written license of said company.

The full legal penalty will be promptly enforced against all dentists, as well as their patients, making unauthorized use of any such patented denture.

A reward will be paid by said company to persons furnishing it with any cases of bridge work of one, two or more crowns made by any dentist not licensed by this company.

SIGNED: International Tooth Crown Co.

To intimidate the profession, a number of suits were commenced against prominent dentists in various cities.

Fortunately, throughout history there have always been a few fearless men who would not bow to tyranny. It is to those men that humanity owes whatever liberty it has attained up to the present. Dr. J. N. Crouse, a dentist practicing in Chicago, belonged to those courageous few who do not submit, regardless of consequences to themselves. Crouse could have purchased a license as other dentists had done, but instead he decided to fight. Single handed, he started to organize the United States Protective Association for the purpose of defending the profession against the extortions of the International Tooth Crown Company.

We might imagine that, under the circumstances, the profession whose very livelihood was threatened would have rushed to join the Protective Organization en-masse. Unfortunately, the profession had the same failing as the rest of humanity. (Like the majority of people, dentists are short-sighted, selfish, and blind to their own best interests.) In order to enlist sufficient backing and enough money to carry on the litigation, Crouse was obliged to travel all over the country, speaking to dentists individually and in groups, attending meetings and conventions and actually pleading with them to join the organization. Yet in spite of his efforts and several years of hard work during which he was away from his office most of the time, all he was able to collect was sixty thousand dollars, from about six thousand dentists.

Sixty thousand dollars may sound like a lot of money to most people, but it does not mean very much in paying the costs of extensive patent litigation. The International Tooth Crown Company which had hoped to make a fortune from its patents was not ready to relinquish that possible fortune without a hard battle. The case dragged on for years, through various courts. It was not until 1900 that all the crown and bridge patents were finally invalidated and the dentists of this country freed from unjust exploitation.

Dr. Crouse had saved dentists a lot of money and had preserved the future progress of his profession, but in the meanwhile his practice was neglected, and when it was all over he was financially ruined. A penniless old age stared him in the face.

But Crouse was a man with a great deal of energy; a man who could not be defeated easily. Having concluded that it was no longer possible to rebuild his practice, he decided to embark into the dental supply business. We can readily appreciate his desire under the circumstances to recoup his shattered fortune. However, Crouse had always been an idealist who saw wrongs which he thought should be corrected.

Crouse believed that dental supply dealers were exploiting the dental profession through excessive charges for materials and instruments. He was also very much disturbed by the fact that most dental journals were the property of manufacturers or dealers in supplies. This, he was convinced, was contrary to the best interests of the profession, because it inhibited free expression of opinion, and prevented criticism of exploiters. Crouse's motives in entering the supply business were therefore very much mixed.

Several of his friends had advised against entering into competition with established supply businesses. Some were of the opinion that the charges

for supplies were not at all exorbitant, considering the large overhead costs in proportion to sales. The dental profession as a group demanded an unusual amount of service which was costly and which the dealer was obliged to add to the price of his products. They also pointed out that so long as dentists were unwilling or unable to support their own professional publications, the dealers were really performing a good service, even though their motives were not entirely unselfish.

But Crouse would not be dissuaded and he organized the U. S. Dental Supply Company for the purpose of manufacturing and distributing supplies under the high sounding name of "Fellowship." The avowed plan was to give every member of the U. S. Dental Protective Association a rebate of ten per cent on his purchases. Along with the supply company Crouse also established a journal—*The Dental Digest* of which he himself became the editor.

Crouse's enterprises were unsuccessful. The supply business failed; whether that was due to poor business ability or lack of professional support it is hard to tell. In all probability, both factors contributed to the disastrous result. The *Dental Digest* continued under his direction for a while, but again Crouse's hope was frustrated and his dream of an independent dental press unrealized. The *Dental Digest* was finally acquired by a supply company and was later transferred to a dental publishing company which retained the old name, but turned it into a pictorial.

Crouse died in 1914, a poor man! Unfortunately, his valuable service to dentistry had not received proper recognition, because he financed the supply business with funds which belonged to the Protective Association. That money was lost when the supply business failed. In other words, he had misappropriated funds which did not belong to him.

Some of his friends defended Crouse because, according to the by-laws of the Association, he had the right to vote all the proxies that had not indicated their choice, and therefore he had legal control of the Association and could use the funds in its treasury according to his own judgment. They pointed out that his motives were not entirely selfish for he really believed that he was working for the best interests of the profession, hoping to save dentists a great deal of money on their supply purchases. Still another defense was that since Crouse had given so much of his time without any compensation whatsoever and had saved dentists of this country many thousands of dollars which they might have had to pay the International Tooth Crown Company in royalties, he was justified in using the Association funds to restore his depleted finances.

To what extent these defenses may be valid is a matter of opinion. A far more serious criticism of Crouse lies in his behavior in the Taggart inlay patent case. As head of an organization formed to fight dental process patents, Crouse had always preached against such patents in dentistry and insisted that they must not be allowed to gain a foot-hold in the profession, because they were detrimental to the progress of dentistry and inimical to public welfare. Yet in spite of all his preaching he made a deal with Taggart about 1911 in behalf of his membership to purchase licenses which gave them the right to use the inlay process. This arrangement recognized the validity of those patents and was a complete reversal of his previous position. No wonder men like Holly B. Smith of Atlanta, Ga., and George Wilson of Cleveland, Ohio, were opposed to the deal! Others, like Mark Finley of Washington, D.C., or Richard Summa of St. Louis, Mo., who had always been among his active supporters, even accused him of selling out to Taggart for private gain.

In retrospect, it is perhaps possible to understand the motives and reasoning that influenced his actions. To begin with Crouse never doubted that the Taggart patents were absolutely valid. This belief was shared by several patent attorneys of wide experience. Crouse therefore felt that when Taggart agreed to accept fifteen dollars for a perpetual license to make inlays under his patents, he had struck a good bargain and had saved the profession much money and considerable annoyance, for he recalled the troubles of dentists during the days of the vulcanite patents and the International Tooth Crown Company litigation. He was afraid of what Taggart might do after the validity of his patents had been established.

Besides Crouse was getting old and tired. He had fought valiantly for the dental profession in the face of discouragement and against great odds. At best, the support of dentists had been half-hearted and niggardly. He was reluctant therefore to start another campaign for additional funds to begin a new series of litigations. This time, too, he would have had to fight not some strange and greedy business man, as before, but a personal friend (Crouse and Taggart had been friends for years). Furthermore, Crouse believed, and many prominent dentists agreed with him, that Taggart deserved to be rewarded for his great contribution and that the profession should be glad and willing to pay him the small sum of fifteen dollars for the benefits derived from the inlay process.

All this may explain, but it does not really condone, Crouse's actions. If age, or friendship, weakened his inclination to enter upon a legal battle, he should have stepped out and allowed a younger man to take up the

burden. Certainly, he should never have made an agreement to purchase licenses and thereby accept the validity of Taggart's patents without a contest. The matter was far too important to permit of compromise. Though it was true that Taggart deserved some compensation, the method which Crouse had chosen was entirely wrong and contrary to the ethical concepts of the profession.

The United States Dental Protective Association is still in existence; there is a board of directors which meets annually. Many of the original members are dead. The fund in the treasury, which has been accumulating for the past several years, must now run into a sizable sum. This fund is in the hands of three trustees—all living in Chicago. Since the original purpose of the Association which was to defend the profession against process patents has now been taken over by the American Dental Association we may well wonder why the organization continues to exist and what will become of the money when the remaining members and the trustees have passed away.

CHAPTER XXIX

AN ENGLISHMAN ATTACKS AMERICAN DENTISTRY

William Hunter, an English physician, whose practice was largely among the well-to-do people of London, had a number of patients confined to bed with apparently obscure ailments which were called "general debility," a term that physicians had often used wherever they were unable to make definite diagnosis.

Hunter noticed that some of these people had a great deal of "American Dentistry" in their mouth, such as crowns and bridges. The bridges were usually unclean and roots above the crowns where the gums had receded were badly discolored. Some looked green and unhealthy; the odor from the patients' mouths was fetid.

Accordingly, he suggested to several of the worst cases that it may help if these bridges, including the roots to which they were affixed, were removed. Hunter was not thinking of focal infection; he merely believed the invalids would feel more comfortable if their mouths were clean. But since the dental work had been rather costly and in some instances meant parting with a fairly comfortable chewing mechanism plus facial disfigurement, most of the patients objected to Hunter's advice. A few, however, decided to permit the removal of the bridges, teeth and all.

Much to the surprise of both Hunter and the patients, some of the invalids began to show decided improvement when relieved of the American Dentistry. Their health became much improved and several were able to leave the hospital and resume their previous occupations. Of course, this did not occur in all cases, but the results had been striking enough so that no intelligent physician could overlook them.

After recording a number of observations, Hunter read a paper before the Faculty of Medicine of McGill University at Montreal, in 1911, roundly

criticising "American Dentistry," and referring to the ingeniously constructed dental bridges as "mausoleums of gold over a mass of sepsis." According to Hunter, cases of anemia, colitis, arthritis, kidney disease and many other ailments could be traced to infection around the teeth. He cited a number of case histories of patients who had been ill (some even bed-ridden for months and years) and who had recovered entirely, or had been very much improved, as a result of the removal of the artificial restorations and the teeth which they carried.

There was nothing new in Hunter's address at McGill, so far as the dental profession was concerned. Miller had called attention to the subject over twenty years before. But it happened that Hunter's findings were presented to a group of physicians. In addition, *Current Literature,* a popular magazine with a wide circulation, had picked up the story and the topic was receiving an unusual amount of discussion and publicity. The dental profession began to discuss "oral sepsis" almost to the exclusion of any other phase of dental practice.

At first the dental profession was shocked and indignant with Hunter's severe indictment of accepted methods practiced by the dentists of this country. Many teachers in dental schools who had been insisting that no tooth should be used as an abutment for a bridge without first removing the pulp, and whose teachings were therefore responsible for the infection of millions of teeth objected vociferously to such strong condemnation of their teaching.

But their protests were of no avail. No amount of argument could refute the facts underlying Dr. Hunter's criticism. Soon, this had ceased to be merely a dental problem. The medical profession began to recognize the seriousness of infected teeth. Recalling their anatomy, they suddenly remembered the close association that exists between the teeth, the gums and the arterial system. It dawned upon them at last that while a tooth abscess can do but little damage at the point of its original location, infectious organisms may enter the blood stream. Lodging in some vital organ or tissue, those organisms might become a menace to health or even to life itself.

The theory of localization, too, was not novel. Attention had been called to it several years earlier. In 1904, Dr. Frank Billings, a Chicago physician, published an article emphasizing the effect of localized infection in certain heart lesions. Later, his colleague, the brilliant bacteriologist Dr. Edward Rosenau, added strong confirmation to Billings' findings. But it was not until Hunter's dramatic presentation, fostered by wide publicity in lay publications, that the medical profession became aware of the oral

cavity as a part of the human body. So, from absolute disinterestedness, physicians rapidly went to the opposite extreme. They began to blame the teeth for almost every disease which they could not readily diagnose. Indiscriminate extraction became the order of the day. No matter what the patient's ailment, headache or stomach-ache, his teeth had to come out. This over-enthusiastic acceptance of oral sepsis and faulty dentistry as a possible cause of many puzzling conditions soon spread to the dental profession and the wholesale removal of teeth became common practice in many dental offices.

The majority of dentists were altogether bewildered by this turn of events. It was difficult for them to believe that the efforts of many years had been discredited and that all the skill and ingenuity so laboriously developed had become worse than useless. Furthermore, while it was a simple matter for physicians to condemn teeth and order their removal, since each physician's main concern was the health of his patient, the dentist had a different problem to face. After the teeth had been extracted, it was his job to replace them with artificial substitutes. If bridges and crowns were taboo, how should these vacant spaces be filled? For esthetic reasons, and for the purpose of better mastication, the public demanded some kind of mechanical restoration. Partial plates, particularly the smaller pieces containing just a few teeth, were not comfortable and most people refused to wear them.

There was still another problem in many cases. Wholesale extractions did not seem to bring the expected results, and sanguine hopes of recovery were not always realized. Many people, young and old, had their teeth removed, their mouths wrecked and their faces disfigured without apparent improvement in their health. Frequently, the psychological effect of being toothless even aggravated their condition. Many dentists began to wonder whether the enthusiasm for wholesale extraction had not over-reached itself.

Was it possible there was some mistake; that not all of the teeth from which the pulps had been removed were responsible for the diseases ascribed to them? If so, how could the differentiation be made?

CHAPTER XXX

THE X-RAY COMES TO THE RESCUE OF THE DENTAL PROFESSION

One late Friday afternoon in November 1895, Professor William Conrad Roentgen, director of the laboratory at the University of Wurtzberg, Germany, and his two assistants were conducting experiments in connection with the passage of high voltage electric current through vacuum tubes. This had been done before, but they were simply repeating and checking the observations of other physicists in the field. The assistants left, but Professor Roentgen lingered to finish a few minor details, he was about to throw off the switch, when suddenly his eye caught a strange glow on the table a few feet away. The room was pitch dark; the vacuum tube had been covered with a black screen. Carefully, in the darkness, Roentgen made his way to the table. He found that the glow came from a few barium crystals on a piece of paper that were evidently shining by reflected light. But from where did the light come? He examined the screen over the tube. It was in perfect condition; no break anywhere. He turned the current off and the glow disappeared. Again and again, he opened and closed the switch. When the current was flowing through the tube, the crystals glowed; when the current was off, the glow was gone.

There could be but one conclusion. In its passage through the vacuum tube the powerful charge of electricity emanated some kind of ray which penetrated the solid dark screen and was reflected by the crystals on the table. The professor was probably late for dinner that evening. What revolved in his mind at that time no one knows except that he made a chance remark to a friend afterward:

"I've discovered something interesting, but I don't know whether or not my observations are correct."

In order to be sure, he isolated himself completely in his laboratory for

the next eight weeks; slept and ate near his apparatus and allowed no one to disturb him.

During the two months of his feverish labor, Roentgen made a great many experiments. He moved the screen to further distances; he interposed the rays with materials of greater density, books and wood and even sheets of metal. He found variations in the degree of penetration related to the density of the materials used. Only lead and platinum stopped the rays completely. And by holding his hands in front of the screen, Roentgen was the first to behold what no human eye had ever seen before, a perfectly clear outline of the bones in his hand, visible through the flesh.

X-ray ranks with anesthesia as one of the two greatest discoveries that have revolutionized the medical and dental professions. Today, it is almost impossible to imagine practicing either profession without the aid of this wonderful discovery. Within three months, experiments in medicine showed the value of the new invention. The first x-ray of teeth was made by Dr. W. Koenig of Frankfurt in 1896. The films were crude, but they showed the roots distinctly through the jaw-bones and the pulps in the center of the teeth. On April 24 of the same year, Dr. W. J. Morton of New York gave a demonstration of the x-ray before the Odontological Society of that city. Some claim that credit for the first x-ray film in this country belongs to Dr. C. Edmund Kells.

As often happens with new and important discoveries, there was much enthusiasm at the beginning. Some thought that the new ray had ushered in the millenium in the practice of medicine. A physician had only to look into the human anatomy to diagnose correctly every ailment! Then a reaction which was due largely to the crudeness of the apparatus and faulty technique set in. We are not surprised therefore that the president of the British Physical Society should have expressed the opinion that:

"At present I do not see how it (the x-ray) can lead to results of any significance." A similar opinion was expressed by another medical authority. The prize comment, however, appeared in the *Pall Mall Gazette* of London, after Roentgen announced his discovery. In an issue published in March, 1896:

"It is now said, we hope untrue, that Mr. Edison has discovered a substance, tungstenate of calcium is its repulsive name, which is potential —whatever that may mean— to the rays. The other consequence of which appears to be that you can see other people's bones with the naked eye and also through eight inches of solid wood. On the resulting indecency there is no need to dwell. But what we seriously put before the attention of the

government is, that the moment tungstenate of calcium comes into anything like general use, it will call for legislative restrictions of several kinds."

This may sound facetious, although Roentgen biographers seem to be satisfied that the statement in the *Pall Mall Gazette* was made in all seriousness. These criticisms, however, made no impression. Roentgen was not burned in effigy. Even the clergy kept its peace, though it might have readily found a Biblical text upon which to base its condemnation of the x-ray as a diabolical invention, which enabled mankind to uncover the mysteries that the Lord in his wisdom had designed to remain hidden.

The world had changed in the fifty years since Morton, the discoverer of ether anesthesia, was hounded to his death as an enemy of society and a disciple of Satan. Within a short time, Roentgen was acclaimed all over the world as a great benefactor of humanity. Many countries have perpetuated the name of Roentgen by calling the films "Roentgenograms." But in the United States, with our penchant for brevity, the length of the word and its lack of euphony could not compete with the short and terse term—"x-ray."

Dr. C. Edmund Kells, of New Orleans, was perhaps the first dentist to attempt the use of the x-ray machine in connection with the teeth. Several others followed his example, but the profession at large remained uninterested. In 1906, almost ten years after he began his experiments, in order to give a demonstration before the Southern Dental Society, Kells was obliged to transport his entire equipment to Asheville, North Carolina. There was no x-ray machine in Asheville at that time. Dr. Kells' contribution to the development of x-ray in dentistry finally cost him his life. Nothing was then known about the hidden dangers lurking in the strange penetrating ray. Many of the pioneers, using the early crude machines were badly burned or maimed. Dr. Kells first lost three fingers, later his whole hand was removed and then his arm had to be amputated. But even that did not help. Preferring death to long and continuous suffering, Kells committed suicide—another unsung hero who gave his life for humanity.

Danger from the x-ray has now been removed by placing the operator behind a lead screen and covering the vacuum tubes with shields of "lead glass."

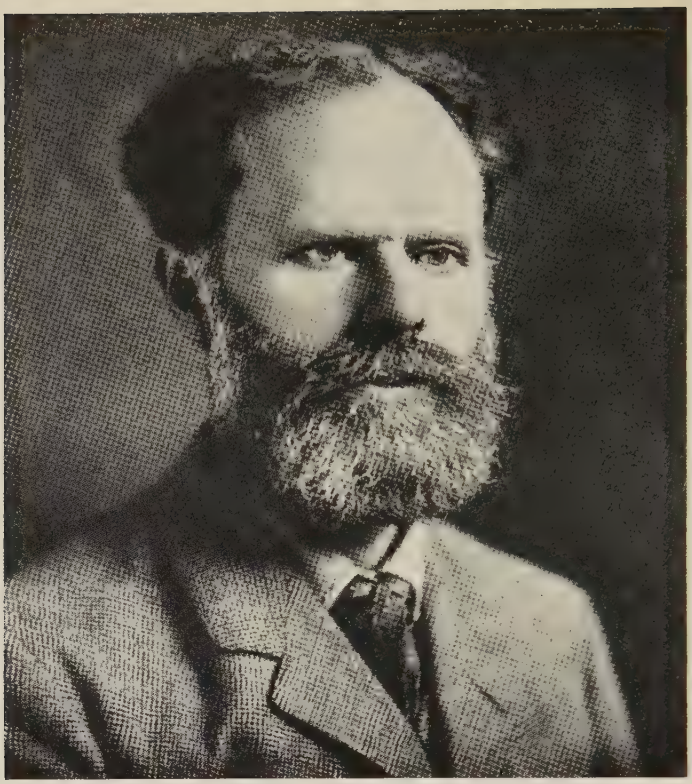
When the problem of wholesale extraction arose, the dental profession turned to the x-ray in the hope that it might offer some solution to the problems that Hunter's attack had forced upon them. Dental films, of course, do not indicate the presence of pus above a root or the existence of pyorrhea or abscesses. They merely record differences in densities, but a

SIR WILLIAM HUNTER

Sir William Hunter, M.D., F.R.C.P., was born in England in 1861, where from his entrance into medicine he became intensely interested in oral sepsis. As early as 1900, as the result of his observations on the systemic reactions of oral sepsis that he believed were attributable to faulty dental appliances, he published a monograph on "Oral Sepsis," but his writings fell on deaf ears, as had the writings of those who preceded him, notably Miller's in his presentation of "The Human Mouth as a Focus of Infection."

In 1910, however, Dr. Hunter found an appreciative audience in the Faculty of Medicine of McGill University, Montreal, Canada, where he delivered before the opening session an address entitled "The Role of Sepsis and of Antisepsis in Medicine," which attracted such serious attention of the medical profession generally that for the moment it almost completely demoralized and threatened to change the whole complexion of dental practice. In fact, it did so influence the conception of dentistry that the question of medical education preliminary to dental education received serious consideration from some dental educators.

While it is evident that this is not by any means the consensus of opinion of the dental profession, it is evident that Hunter's revelations will influence the future development of dental education to the extent that more medical knowledge will be incorporated in the dental curriculum, but as supplementary to dental education.



DR. WILLOUGHBY D. MILLER

Willoughby D. Miller, M.A., D.D.S., Sc.D., LL.D. (1853-1907), was born in Alexandria, Ohio, in 1853. Dr. Miller's educational preparation was directed toward chemistry and after completing his collegiate education at the University of Michigan, he went to Edinburgh to continue the study of chemistry, philosophy and mathematics. He pursued his studies further at the University of Berlin.

In Berlin, however, through his contact and association with Dr. James Truman and Dr. Frank Abbott in Berlin, he became interested in dentistry and there the course of his education as well as his lifework were changed. He entered the office of Dr. Abbott as a student of dentistry and returned to America to complete his dental education at the Pennsylvania College of Dental Surgery, later at the Dental Department of the University of Pennsylvania, from which latter institution he received the degree of D.D.S., in 1879.

He then returned to Germany and began the practice of dentistry. He soon made a name for himself in his profession and became associated in a teaching relation with the University of Berlin. It was here that he did his notable work in bacteriology under Koch. His most widely recognized work, "Microorganisms of the Human Mouth," became a classic in bacteriological literature, and today has not been superseded. The above, and his other scientific work, published largely in the *Dental Cosmos,* distinguished him as the outstanding scientist in dentistry. It was his work that was largely instrumental in establishing dentistry as a science, and also became a most potent influence in the development of dentistry along scientific rather than purely mechanical lines. In 1906 Dr. Miller returned to America to become associated with the Dental School of the University of Michigan in a teaching position, an ambition he had entertained throughout his stay in Berlin, but his death occurred before he could assume his new relationship.

dark area at the root suggests bone destruction that may have been caused by micro-organisms. And, similarly, a decrease in the normal bone shadow covering the roots is evidence of bone absorption due to pyorrhea.

Focusing the penetrating rays on the jaws, dentists discovered that the bone over the roots of abscessed teeth or in the proximity of pus-discharging fistulae offered only slight resistance to the x-ray. Some areas produced shadows that were entirely black in the x-ray film, indicating that complete bone-absorption had taken place, a condition that could be ascribed only to long and continuous infection. Healthy teeth with or without fillings which still contained the pulps showed no such abnormalities.

While dentists studied the physical manifestations of these conditions, pathologists all over the country became interested in the bacteriological side of the problem. Experiments with cultures developed from the shadow areas around the suspicious teeth often indicated that these areas might be responsible for many ailments in other parts of the body.

Another discovery was that the dark shadows were not confined only to those teeth which were definitely abscessed, discharging pus through the gums. The x-ray films frequently disclosed suspicious areas of infection in the jaw-bone around many teeth that showed no signs of any disturbance, and had no previous history of ever having caused the patient any trouble. All of those teeth, however, had had the pulps removed by dentists at some time or other. By far the largest number were found to have been crowned, and in some cases doing good service as abutments for bridges.

These findings helped to explain the apparently spontaneous toothaches and abscesses which appeared without warning in "good teeth." It was plain that they were simply "flare-ups" of infections always present but remaining dormant until a decline in the patient's resistance permitted the micro-organisms to become active. These studies explained early suspicions in connection with sudden swellings about the face. They further confirmed Hunter's findings and the few remaining objectors to his statements were completely silenced. The x-ray evidence and the bacteriological findings were beyond dispute.

The problem that continued to baffle the profession was, why do treated teeth become infected at all, while more serious operations in other parts of the body heal perfectly? Was there anything inherent in pulp removal that could be responsible for bone lesions? Another puzzling fact was the observation that not all treated teeth showed rarefied areas at the apices. A large number of teeth without pulps, mostly single rooted, appeared just as normal as those which had never been touched by a dentist. It seemed

strange that the molars should be more susceptible to infection than the incisors or cuspids.

The solution of this problem also gave the answer to the question of why treated teeth became infected. Obviously, since there is no difference between the anterior and posterior teeth or in their surrounding tissues, the only possible conclusion was that the root canal operation itself determined the results. It is obvious that surgical sterility is extremely difficult to maintain in the average dental office and the longer the duration of the treatment, the greater the possibility of infecting the canals, through the finger or instruments of the operator. Pulp removal in the anterior teeth, which are easily accessible and straight, because of the short time required to finish the operation, can usually be done under complete aseptic control. The danger of infection increases with the number and the shape of the root canals; in the multi-rooted molars the possibility of contamination is in proportion to the length of time it takes to fill the canals. In short, the operator and not the operation, often must carry the blame for apical infection and considering the difficulties of root canal treatment, he, too, may frequently be absolved. An added disadvantage of root canal surgery is that the alveolar bone, like all other connective tissues, has only a limited blood supply and does not possess sufficient vitality to resist micro-organic invasion. Once the infection passes out into the apical space infection is almost inevitable.

Teeth from which the pulps have been removed are now referred to as "pulpless" but twenty years ago they were commonly called "dead teeth." Who used the term first or how it entered the vocabulary of the profession is not known. Unfortunately some words have a connotation which, through association of ideas, conjure certain thoughts in our mind. When we speak of something that is dead, we immediately think of an object that must be disposed of at once. It was perhaps this erroneous misnomer that accounted for the obsession of many dentists during that period that "all pulpless teeth," even though the apical areas appeared normal in x-ray films, must nevertheless be removed because they were "dead."

Dentistry, like other vocations, is not free from what Theodore Roosevelt once called the "lunatic fringe." In every line of human endeavor there are a certain number of people who are inclined to emotionalize their opinions and with the best intentions, they are apt to cause a great deal of harm. In some sections of the middle-west this "fringe" organized "total vitality" groups whose credo was "every tooth from which the pulp has been removed is a dead tooth; all dead teeth are a menace to health, therefore must

be extracted immediately." In their enthusiasm the 100% vitalists began an orgy of wholesale extraction and an unwarranted sacrifice of many pulpless but otherwise good teeth, that was tragic in its consequences. They wrecked and ruined the mouths of young and old and we still meet some of their victims wearing false teeth that should never have been necessary. These people suffered mental anguish and needless discomfort because they trustfully accepted the advice of that "lunatic fringe."

Intelligent and clear thinking dentists were not carried away, of course, by the total vitality slogans. They saw no reason for the removal of teeth which the x-ray showed to be in normal condition. A tooth without a pulp does not lose its contact with the blood circulation and therefore continues as an integral part of the anatomy. The one hundred per centers have gradually disappeared and we do not hear very much about them any more.

Dentistry is naturally not proud of this incident, but it has no occasion to apologize. Medicine, with its longer history, has a great number of similar episodes which it would be happy to forget.

But indiscriminate saving of teeth and roots is now a thing of the past. With the aid of the x-ray the dentist is able to determine which teeth may be removed and which may be left in the mouth with safety. No longer may the dental profession be accused of erecting "mausoleums of gold on a mass of sepsis."

CHAPTER XXXI

THE CAST GOLD INLAY

For over forty years, the profession had been pounding gold into teeth. Day after day, busy dentists would spend from one to four hours to complete a single filling, slowly condensing the foil pellet by pellet. During all those years the dental profession hoped that some day a new method might be found to fill teeth with gold; a simpler, quicker method.

From time to time, dentists attempted to turn this dream into reality. Some experimented with various types of matrix inlays, similar to the method employed in baking porcelain, except that the matrix was filled with gold solder. The results of these experiments, however, were negligible. The technique was too complicated and the inlays seldom fitted the cavities. For a long time it seemed that the dental profession would remain chained forever to mallets and gold condensing pluggers.

And then, quite unexpectedly, the dream became reality. The profession was given a simple technique for casting gold inlays; the whole process down to the very last detail. Through this process, every dentist was able to produce perfect inlays easily and quickly. He could throw away his gold condensing instruments; no longer need he stand for hours in one position, to complete a single foil filling. Patients, too, were grateful. They were freed from the boredom and discomfort formerly endured; freed from rubber dams, hammering and protracted sitting in the dental chair.

The man who rendered this very great service to the dental profession was Dr. William H. Taggart, a Chicago dentist. In February, 1907, at a meeting in Brooklyn, New York, he disclosed his wonderful inlay casting method. It was very simple. A piece of wax was placed in the cavity and formed to the shape of the desired filling. The wax, invested in a

mold, was dissipated over a flame and the resulting space filled with gold by means of a pressure apparatus. The finished filling, a duplicate of the original wax pattern, was then cemented into the tooth.

The enthusiasm at that meeting is almost indescribable. Taggart was hailed as the greatest benefactor of the dental profession, and he told his listeners at the close of the meeting how happy he was to serve dentistry. He suggested that they go back to their offices, use his process, and reap all the benefits. But he neglected to tell them that an application for patents on the process was at that very moment resting in the files of the patent office in Washington. It is, of course, possible that this escaped his mind. A more reasonable assumption is that after the great ovation given him, Taggart did not have the courage to inform his audience that he had already arranged for the legal weapons which would force the profession to pay him royalties for the use of his invention. Taggart knew, of course, that the dental profession had always frowned upon process patents; that Dr. Black had never asked one penny for his amalgam alloy formula; that Dr. Arthur had received no money for his process. Either of these men could easily have enriched himself, had he chosen to patent his contributions to the practice of dentistry.

It has been urged in defense of Taggart that his original intention was not to seek compensation by selling office rights; that his only reason for patenting the process was to promote and foster the sale of his casting machine. This defense becomes rather weak when one considers that the price of the machine was set at one hundred and fifty-five dollars, about three times its actual value. What difference did it make whether Taggart charged a hundred dollars for his license, or by means of the patents forced the dentist to pay him a hundred dollars extra for the machine? Taggart, indeed, was more frank than his friends. For when he filed suits against a number of dentists for infringement, he made the statement, "I have retired from dentistry. I am a business man now and I am going to get all I can out of my invention."

We must not, however, judge him too harshly. It is easy to talk glibly about professional ethics when nothing is at stake. But how many dentists would have acted differently had they been in Taggart's place? How many would have willingly foregone the opportunity to amass a large fortune, because the collection of royalties was contrary to the tradition of dentistry?

After his appearance in Brooklyn, Taggart gave a number of demonstrations at many dental meetings all over the country. Everywhere den-

tists were impressed with the simplicity of the technique and the perfection of the finished inlays. Taggart's pressure casting machine, which he used at his demonstrations, was the acme of efficiency and he was showered with orders; many of them with payment of the full amount ($155.00) in advance. It was estimated, that the total value of these orders was almost two hundred thousand dollars. Unfortunately, his plant was not organized for mass production and when the orders began to pour in, he was unable to take care of them. His manufacturing facilities broke down completely and for a long time he could make no deliveries.

Meanwhile other men saw an opportunity for quick profits and began to supply the demand for casting machines. Soon the country was flooded with vacuum, centrifugal, and pressure apparatuses, which worked smoothly and perfectly at from one sixth to one-twentieth Taggart's price. When Taggart was at last able to produce machines in quantity, he found that his market had disappeared. Most of his orders were cancelled and he was obliged to refund the deposits which a number of dentists had given him.

It was at this time that J. N. Crouse began his negotiations with Taggart for the purchase of licenses. This was no simple task, for Taggart had a rather high opinion of the service which he had rendered the profession. Dentists were making hundreds and thousands of dollars from his inventions! He felt that he was entitled to a sizable share of the increase in their incomes. It has been said that at first Taggart asked for three hundred dollars, and when he finally agreed to accept fifty dollars, which on the basis of seventeen years (the life of the patent) amounted to only three dollars per annum, he thought that he was more than fair. Crouse, however, was a persistent negotiator and he finally succeeded in persuading Taggart to accept the small sum of fifteen dollars per license. The arrangement was that the United States Dental Protective Association would act as the distributing agent for those licenses. Those who were already members would pay no more than fifteen dollars, while others would have to join the Association first, at a membership fee of ten dollars, making their total payment twenty-five dollars. Taggart would receive his money from the Association in lump sums without any expense or effort on his part.

We can readily imagine the arguments which must have finally induced Taggart to accept Crouse's proposition. It was a reasonable assumption that at the low price of fifteen dollars and with the prestige of the United States Dental Protective Association supporting the agreement, nearly

every dentist in the country would be glad to avail himself of the opportunity to purchase a license. On the basis of fifty thousand practicing dentists in the United States at that time, cash payment of fifteen dollars would have amounted to three-quarters of a million dollars. In addition, the students who were being graduated every year, would add another thirty thousand dollars or more per annum during the life of the patent. The profession, of course, would be grateful and Taggart would be applauded for his generosity and liberality.

From Crouse's point of view, the agreement also promised decided advantages. In spite of all his efforts the membership in his organization never numbered more than six thousand. The agreement with Taggart offered the possibility of an enrollment reaching forty or forty-five thousand. At ten dollars it would create a fund of four hundred thousand dollars or more and such a large sum of money could serve forever as an insurance against the exploitation of the dental profession through the medium of invalid process patents. For most people would hesitate to enter into a legal contest with an organization so well financed. Incidentally, the income from such a fund would have enabled the Association to pay its president, Dr. Crouse, a substantial salary; enough to take care of him in his old age.

After the agreement was signed, Crouse mailed a letter to every member of the dental profession over his own signature, and supported by the names of J. P. Buckley and C. N. Johnson, advising the profession regarding the terms of the agreement, and urging each dentist to take advantage of the settlement by remitting fifteen dollars for a license plus ten dollars extra for membership fee in the Association, if he had not previously joined.

But the optimistic hopes of Taggart and Crouse were not realized, although several letters were sent out and in some of them Crouse pointed out consequences which might follow if the agreement were not accepted. Only about forty-five hundred dentists, or less than ten per cent of those in active practice, purchased licenses. Taggart received about sixty-five thousand dollars and Crouse even less than the estimated 40% because a large number were already members of the United States Dental Protective Association.

It would be gratifying to believe that the forty-five thousand dentists who refused to accept the compromise agreement were influenced by the professional point of view; that they refused to pay Taggart fifteen dollars because they were opposed to licenses on process patents in dentistry. It would be pleasant to believe that the great majority of the profession were

willing to take a chance on the outcome of possible litigation, and, if Taggart were successful, pay him a much higher amount than Crouse's settlement provided, rather than compromise a principle. This, however, does not seem to have been the reason, because, when organizations were formed later to test the validity of Taggart's patents in the Federal Court, the dental profession continued to remain indifferent and the vast majority disregarded all appeals for financial assistance to pay the expense of litigation. Only a minority, about seven thousand altogether, ever contributed to the cost of the defense. The others stood on the side lines and received the benefits for which they never paid.

A few men scattered through the country sincerely opposed Crouse's plan, because, in their opinion, the agreement was establishing a bad precedent. They would have been glad to reward Taggart for his great services. Fifteen dollars was certainly a small enough sum to pay him. But they were fearful of the future. They were afraid that if Taggart were permitted to collect large sums of money for licenses, other men would soon be tempted to follow in his footsteps, hoping to become wealthy by patenting their processes. The practice of dentistry would then become enmeshed in a maze of patents. Every advancement would be restrained by license and progress would soon stop.

These men were quite ready to admit that as a result of his previous experience in that type of litigation, Crouse's opinion regarding the validity of the inlay patents might be correct. Nevertheless they insisted that he should not have made a compromise with Taggart without first testing the validity of Taggart's claims in the courts.

It was this group of far-sighted men who, under the leadership of Mark Finley, organized the National Dental Protective Association and defended Dr. Boynton at Washington, D. C., in the first suit filed by Taggart for the infringement of his process patent. The organization never had more than a few hundred members, and its appeal for funds to the profession at large received scant attention. But these few hundred, by their generous contributions, carried the burden of the defense. Most of the money came through personal solicitation by Mark Finley of Washington, D.C., George Wilson of Cleveland, Richard Summa of St. Louis, and Gailfus and Hall of Milwaukee. The Boynton case, thanks to the efforts of these men, ended favorably for the profession.

The Washington suit was merely a skirmish, since it involved only two of the minor patents. That case merely helped to sharpen the wits of Taggart's lawyers, and gave them the necessary experience for the grand

battle which was to follow. Among other things, it taught them that it was inadvisable to attack a prominent dentist like Boynton, because he might be able to rally his friends and acquaintances to his support, and another defense association might be organized.

While Taggart's attorneys had no doubt of their ability to establish the validity of the inlay patent, they also knew that the history of patent litigation was full of unexpected surprises. Accordingly, they decided that the best assurance of victory was the prevention of organized opposition. With this idea in mind, they filed the first suit for infringement in Chicago against Dr. Law, an obscure and impecunious dentist.

Just how or why it happened that this man was selected has never been known. In any event, in spite of his poverty, Law managed to hire a lawyer and present a weak defense. The result, of course, was a foregone conclusion. The inexperienced and poorly paid attorney was no match for the battery of nationally famous lawyers who represented Taggart. Judge Landis (Kenesaw Mountain), the present baseball czar, before whom the case was argued, decided that the patents were valid. He could not do otherwise on the evidence which was produced by the contestants. Law was fined three hundred dollars for infringement and ordered to give an accounting of all the profits which he had made on his inlays since the patents had been issued about eight years earlier. The proceedings were kept so quiet that none of the Chicago dentists knew anything about it until the morning after the trial, when a short news item appeared in one of the papers. Even then, very few dentists noticed it or gave it more than superficial attention.

Soon after the Landis decision, a man appeared at a number of local dental offices, presumably to demonstrate Taggart's inlay wax and inlay investment, but actually acting in the capacity of a spy. Later, he was able to assert from his own knowledge that the dentists he visited were casting inlays. This man's visit was followed by a letter from Taggart's attorneys, demanding the payment of one hundred and fifty dollars for a license. The time limit was five days, and after that the price was raised an additional hundred dollars. To impress dentists with the seriousness of the matter, attention was also called to the decision in the Law case, and to the results of the accounting before the master in chancery, which ordered Law to pay Taggart fifteen hundred and fifty-one dollars and fifty cents, his profits on inlays, plus three hundred dollars damages for infringement, or a total of eighteen hundred and fifty dollars and fifty cents.

It is doubtful, of course, whether Law ever paid. He probably never had that much money in his life.

Following the original plan not to raise too much disturbance among dentists for fear of stimulating organized opposition, only a few of the letters were mailed each day, but the money soon started to come in rapidly. Some of the dentists concluded that one hundred and fifty dollars was less than the profits and the damages they would have to pay if Taggart took court action against them. They mailed their checks within the specified time limit. A few could not forget that once they might have purchased a license for fifteen dollars, were incensed at being forced to pay ten times that amount and consulted their attorneys. The advice invariably was to meet Taggart's terms, since patent litigation was rather expensive and no individual could afford to undertake a legal battle of this nature at his own expense. In all instances, those who delayed beyond the five days were obliged to pay two hundred and fifty dollars.

Taggart and his attorneys began to dream of millions. Forty-five thousand dentists each paying a hundred and fifty dollars or more would amount to nearly seven million dollars. A sizable sum, even for a successful dentist! True, they only had a district court decision, which was valid only in the northern district of Illinois, but that did not worry them. The United States Dental Protective Association, when making the agreement had pledged itself not to enter any litigation against Taggart. The National Dental Protective Association had been unable to enlist support from the profession at large and whatever funds it had raised from its limited membership had already been spent in the Boynton suit. The rank and file was lethargic and unable to organize. Most of the known leaders had obtained licenses through the United States Dental Protective Association and had legally bound themselves never to join any association whose purpose was to test the validity of those patents. Taggart actually once said "that he had the profession tied up in a knot, and that all those capable of organizing were his licensees, and the rest of the profession were like a bunch of sheep." What he meant, of course, was a herd of sheep without a shepherd. For a while the shearing continued smoothly and uninterruptedly and there seemed to be no reason why it should ever stop.

CHAPTER XXXII

THE DENTISTS' MUTUAL PROTECTIVE ALLIANCE

One of the recipients of Taggart's threatening demand for one hundred and fifty dollars was a dentist in his early thirties. Since his graduation, he had concentrated on the building up of his practice and excepting for occasional attendance at a society meeting he paid no attention to dental organization affairs.

While reading Taggart's letter, this man recalled another letter which he had received some three years earlier urging him to purchase a license for fifteen dollars which would give him the right to use the inlay process. At that time he had but recently become a member of the Chicago Dental Society. He was unfamiliar with the work of J. M. Crouse and the Dental Protective. He did not enjoy the acquaintance of Johnson and Buckley. Their signatures on that letter meant nothing to him. It seemed to him that it was merely a scheme to collect money from gullible dentists, and he supposed that the officers of the Society would probably put a stop to it, since the very idea of process patents was contrary to the ethical concept of the profession.

But evidently nothing had been done and now it had become a serious matter. He had no objection to paying a hundred and fifty dollars for the benefit which he derived from the casting process. It was worth at least that much. But he was opposed to the method used in collecting the money. Since the practice of dentistry is nothing more than a series of processes, which are constantly improving and developing, he felt that, if such a precedent were permitted to become established, dentistry would revert to conditions prevalent before the days of Fauchard. Every dentist would be guarding his own secret methods of practice from his competitors, and instead of sharing their knowledge, dentists would rush into the patent office hoping to profit from their inventions and the progress of dentistry would be retarded.

The medical profession, with its older tradition and longer experience, had recognized this, and had always frowned upon patents, even those trying to protect instruments or formulas. Dentistry, however, being so largely mechanical was forced to be more lenient, and had to permit machine patents. But processes was another matter and such patents did not permit of any compromise. He was certain that the leaders in dentistry could not fail to appreciate the seriousness of the situation.

But upon investigation, very much to his surprise, this dentist found that nearly all of the prominent men in Chicago were holders of Taggart's licenses, and because they were safe, were entirely unconcerned with the difficulties of the average dentist who had no such protection. They seemed completely disinterested regarding the future of dentistry. Some of them even gloated at the predicament of the rank and file. Everyone had had his chance to buy a license for fifteen dollars. Those who did not, they felt, had only themselves to blame. It served them right if they were obliged to pay one hundred and fifty dollars.

This young man was rather puzzled. He could not understand how intelligent professional men, holding prominent positions in dental affairs, should have failed to realize the dangerous possibilities of the situation. And so, after considerable hesitation and without any particular plan in mind he decided to consult an attorney, Lynn A. Williams.

This attorney, about the same age as that of the dentist, had but recently severed connections with his senior partner and had gone into practice for himself. He had plenty of time and was quite willing to discuss the inlay patent situation with which he was familiar because of some legal experience in connection with a vacuum inlay casting machine.

During the discussion, the lawyer pointed out the difficulty of defeating those patents and the doubtful outcome of the litigation. But the dentist thought that, in view of the principle involved, the profession should, as a matter of course, oblige Taggart to prove the validity of his patents before paying him for licenses. Should Taggart win, as seemed probable, the legal contest would serve as a warning to others that patents on dental processes are not an easy road to riches. Such action would probably discourage most dentists from rushing to the patent office and would save the profession a great deal of trouble.

The conference lasted through the whole afternoon of a long summer day. The lawyer finally agreed to undertake the defense and carry the case through the court of appeals for the sum of eight thousand dollars. The

dentist hoped he could raise that amount by enlisting the support of one thousand members at ten dollars each. This would allow two thousand dollars for organization expenses.

In the years that followed the two men have often laughed at their inexperience. It was indeed fortunate for the dental profession that neither of them realized the magnitude of the task or the difficulties which they would have to face. Instead of eight thousand, the cost of litigation was nearer to ten times that amount, and this large sum had to be raised from an indifferent profession and against the opposition of many men prominent in dental affairs all over the United States.

The following Tuesday, June 18, 1916, twenty-eight dentists met at the attorney's office and organized the "Dentists' Mutual Protective Alliance" electing M. D. K. Bremner, the man who called them together, as President, V. P. Cooley as Secretary and several directors. Most of the original officers remained until the organization was disbanded. Never in dental history has such an important responsibility fallen on weaker shoulders. Neither the president nor any of the officers had had any previous experience; they were unknown and untried men. It was very doubtful if they would be able to raise the necessary funds, or if the profession would have any confidence in them. But there was no choice, since recognized leaders had refused to have anything to do with the matter.

The organization of the Alliance was followed at once by infringement suits, against the president and the officers. To discourage dentists from joining, Taggart's attorneys applied to Judge Landis for access to the membership records, claiming the sole aim of the Association was to contest the Taggart patents and that, therefore, every member should be made a party to the suit. In vain did the Alliance attorney point to the by-laws which made no mention whatever of Taggart or his patents. The Judge decided against the Alliance, and although nine months later the Appellate Court reversed the decision, in the meanwhile, joining the Alliance meant inviting suits for infringement. That, of course, hampered the campaign for new members and interfered with the raising of funds.

However the Landis decision did not extend beyond the seventh district of Illinois which embraced the city of Chicago and a few surrounding counties. The drive for members in the rest of the state could continue without interference. But there was a difficulty. While locally the dentists could be canvassed by personal solicitation, outside of Chicago the campaign had to be made through the mails. The officers of the Alliance who were

unknown to the profession, had reason to fear that their appeal for funds would receive scant attention. To overcome this difficulty they decided to ask the Chicago Dental Society to pass a resolution endorsing their efforts, believing that the stamp of approval given by the Society would be a recommendation of their integrity and the desirability of their effort.

Since the future of dentistry and the immediate welfare of about ninety per cent of the profession was involved, they did not expect opposition. When greatly to their surprise, Taggart's friends and cronies, under the leadership of Hart J. Goslee (now deceased), organized active opposition. Whereupon the officers of the Alliance, which had by that time acquired a sizable following, threatened the disruption of the society. This threat had its effect and a very much emasculated draft of the original resolution was finally passed. Even so, the endorsement of the Chicago Dental was very helpful in the campaign for new members.

The opposition on the floor of the Chicago Dental Society was only one of the many cases of interference with which the Alliance had to contend in the years that followed. On numerous occasions Taggart's friends tried, both openly and secretly, to impede the efforts of the Alliance and to injure its chances for success. For example, the Northern Indiana Dental Society appointed three of its prominent members to serve as directors on the board of the Alliance. Several days later they all resigned, because of the pressure exerted upon them by some of Taggart's Chicago friends. It was whispered later that each one of them received a free license to practice inlay casting as a reward. That of course may not have been true.

An even more flagrant case was a letter written on the stationery of the Second District Dental Society of New York, signed by the president and treasurer, advising the dentists of that city not to join the Alliance or make any contribution to its funds, because the fight in Illinois was not their concern. These men must have known, of course, that the failure of the litigation in Illinois would affect dentists all over the country.

It was this strong opposition which was probably responsible for the rumor, current at that time, that a number of leading dentists were in partnership with Taggart and were supporting him both financially and otherwise.

The ardent support received by Taggart in many quarters was undoubtedly motivated by a sincere desire to see him rewarded for the great services which he had rendered to the dental profession. Many men were incensed by the refusal of dentists to pay him the small sum of fifteen dol-

lars for the great benefits which they received from his invention. In their opinion, the attitude of the average practitioner towards the great benefactor of dentistry was not based either on high motives or professional ideals, but was simply due to a lack of appreciation and a reluctance to part with a few dollars. Another factor, too, was the loyalty of Taggart's fraternity brothers who supported him steadfastly, placing their fraternity obligations ahead of professional welfare.

At the end of the first year the Alliance had enlisted one thousand members, most of them in the state of Illinois, and was able to pay the attorney the eight thousand dollars as per agreement, but it was soon realized that this sum was a small fraction of what would be needed to see the case through the Court of Appeals. Already various court skirmishes and dissolving the five hundred injunctions obtained against members had absorbed a sizable share of the money raised. Of course, the attorney had promised to take care of the entire litigation for that sum, but he was a poor man and it was unfair to take advantage of his miscalculations. The livelihood of every dentist in the country would be affected by the outcome in the Illinois courts and there was no reason why the entire profession should not share in the expense.

To raise funds on a large scale it was necessary to institute a campaign for members throughout the country. But recalling how J. M. Crouse had impoverished himself while trying to fight the International Tooth Crown Company, the officers of the Alliance decided that this must not be allowed to happen again. It was unfair to place the burden upon self sacrificing individuals. Accordingly, they hired an organizer to take charge of the campaign on a commission basis, so that part of the money collected would pay the expense.

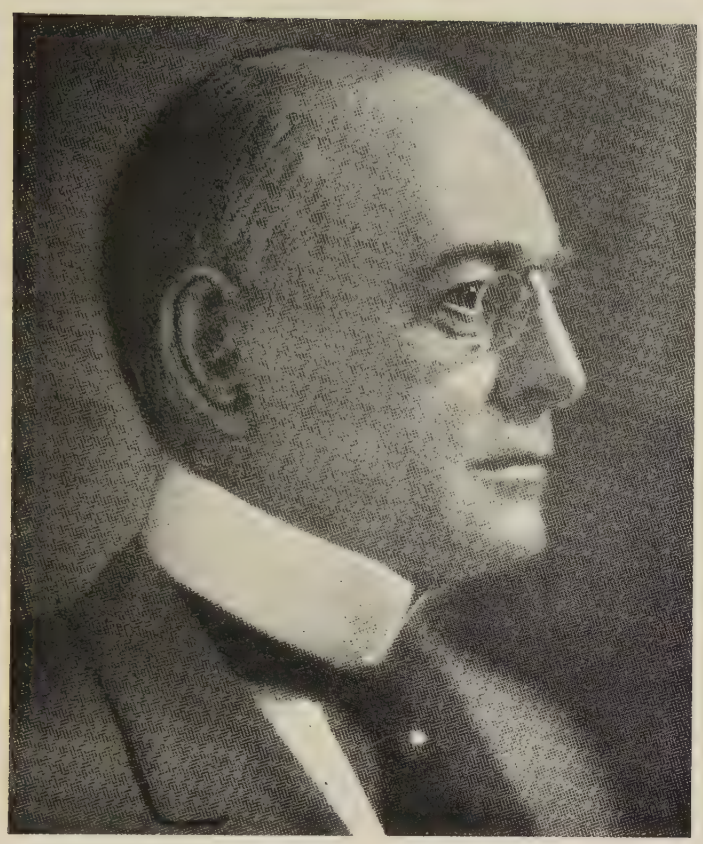
After several extensive mailings to the dental profession throughout the country it became evident that dentists paid little or no attention to letters. It was decided to send men into the dentists' offices for personal interviews. This of course was a very expensive undertaking. Actually, about thirty-five per cent of all receipts were spent for organization costs.

However, in spite of personal solicitation, it was impossible to induce more than seventy-two hundred dentists to join the Alliance at ten dollars apiece. But this was not enough and an assessment became necessary. Only about fifty per cent contributed an additional five dollars each.

In this connection, it may be interesting to observe that the combined membership of the United States Dental Protective Association and the

Alliance was about thirteen thousand which is approximately the same number who have been contributing annually to the American Dental Association Relief Fund for the support of their less fortunate colleagues. Apparently this number represented socially minded dentists in the United States and the ratio would appear to be constant. (In 1936 the number of contributions to the Dental Relief Fund was larger.)

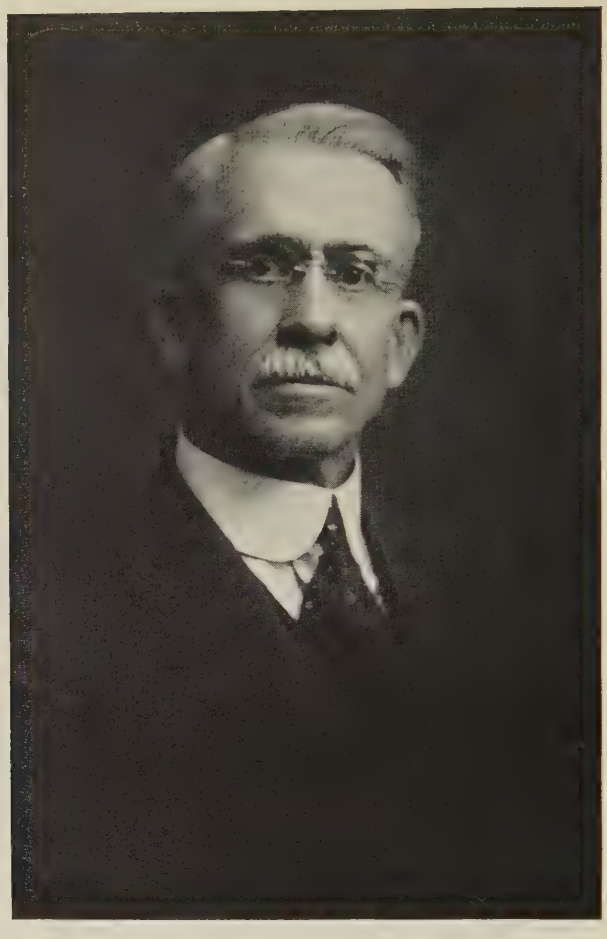
The Alliance collected over one hundred thousand dollars. Ten per cent of this was set aside as a reserve fund for future litigation, if it should ever become necessary. One third was spent for organization expenses and the balance for carrying the inlay patents through the different courts for a final decision. That amounted to about sixty thousand dollars and represented only eighty per cent of the actual cost. At the end the Alliance owed the attorneys a balance of twenty thousand dollars which was never paid.



DR. WILLIAM H. TAGGART

William H. Taggart, D.D.S. (1855-1933), was born in Freeport, Illinois, March 23, 1855. He received his professional education in the Philadelphia Dental College, from which institution he received the D.D.S. degree in 1878. He located in Freeport, Illinois, later removing to Chicago, where he conducted a successful practice for many years. Dr. Taggart was an unusually skillful technician and of the inventive trend of mind. He was continually experimenting on various methods of procedure and eventually developed, in 1907, a method of casting gold inlays by the invested pattern procedure.

This invention by Dr. Taggart has probably influenced, as much as any other one thing, the character of the practice of dentistry since 1907. In fact, it is not too much to state that the casting process revolutionized the practice of dentistry, enabling the profession to deliver more efficient service with the expenditure of much less effort than was involved in the making of the gold filling.



DR. B. F. PHILBROOK

Dr. B. F. Philbrook was born in Camden, Maine on January 13, 1852. Shortly after the family moved to Ohio, settling up on a farm near the village of Jersey. He graduated from high school at Delaware, Ohio in 1870 and taught school for about two years.

The urge to go west took him to Champaign, Illinois and finally to Council Bluffs, Iowa where he entered the office of a friend, Dr. Thomas Weeks, who was one of the pioneer dentists in that section of the country.

Dr. Philbrook remained with Weeks for two years and in 1879 he opened an office in Dunlap, Iowa. He was always keenly interested in mechanical dentistry, and it was at the Columbian Exposition in Chicago in 1893 when his attention was directed to the method of casting aluminum dentures developed by Dr. C. C. Carroll.

The successful results obtained in this field led him to experiment with the casting of inlay fillings. At first he confined himself to the use of low fusing alloys, particularly Watts metal. Later after many trials he succeeded in casting gold inlays.

Dr. Philbrook made a number of cast inlays for his patients before 1897, but was later forced to discontinue these restorations in his practice because of the poor quality of cements at that time. In 1897 he read his famous paper entitled "Cast Fillings" describing his method briefly and further amplifying it in the discussion that followed. Dr. Philbrook, however, was ahead of his time, his audience of rural dentists were unable to appreciate his wonderful contribution and so his work remained dormant for nearly twenty years when it was brought forward by the Dentists Mutual Protective Alliance during the Taggart litigation.

He retired on December 1st, 1937 after a continuous practice in the State of Iowa for 58 years.

CHAPTER XXXIII

THE DEFEAT OF THE TAGGART PATENTS

One of the striking phenomena about the Taggart invention was its sudden appearance and the rapidity of its spread throughout the profession. Prior to 1907, condensed foil was the accepted method for filling teeth with gold. Though some dentists continued to tinker with matrix inlays, the results were not encouraging and there was no intimation of the imminent change which was about to take place in dental practice. For search as one may in the literature, not a single suggestion approximating Taggart's process could be found. But within less than two months after his demonstration at Brooklyn, dentists all over the country were casting inlays, and the dental journals were inundated with papers and discussions on the subject.

These undeniable facts made the defeat of inlay patents rather problematical. Prior art is the foundation of all evidence used in patent litigation. In view, however, of the great utility of Taggart's invention, it was not sufficient to prove that casting metals by burning out the wax was practiced in Greece during the time of Alexander the Great or by the Igarotts in the far off Phillipines. It was not important that the casting of Watt metal or aluminum denture bases was common practice in dentistry. Even the casting of gold dummies for bridgework developed by Dr. Martin of Indiana about 1900, and taught by him to a number of Indiana dentists, had no material bearing on the case. Taggart did not claim to have originated all the different steps which enabled him to obtain his fine results. What he stressed was the application of old methods to a new use, the casting of gold fillings that fitted the cavities accurately. The concept that such fillings could be cast at all was entirely original with him he insisted. No one had ever thought such a feat possible. Prior to his demonstration, no fillings had ever been cast which required only a little polishing before being cemented into place. One of the important steps which he claimed as particularly novel, was the use of a sprue hole so small that even the smallest

filling would not be marred by the resulting slug. Taggart stressed particularly the immense value which his process had been to the dental profession. Not only had dental operations become easier and simpler, but through the universal acceptance of his process, dentists had added thousands of dollars to their yearly income.

Under the circumstances, most authorities agreed that, short of producing irrefutable evidence that some one else had actually preceded Taggart and had cast inlays prior to 1907, the validity of his patents would not be upset. But the possibility of finding such prior use was not very promising. The only hope rested upon the fact that sixty thousand dentists in the United States were all thinking about the desirability of finding a simpler method for filling teeth with gold. It was just possible that some one else besides Taggart might also have stumbled upon the process. True, dental literature contained no reference to any cast inlay disclosure. But, that did not entirely eliminate the possibility of such an occurrence. There was the case of Dr. Long who invented ether anesthesia. His work was never published and it remained unknown, until Morton made the discovery independently a couple of years later. Of course, that happened in 1840 when communication between the different sections of the country was much slower. Even so, it did not preclude the possibility of its happening again.

Based upon this assumption, every rumor of inlay casting was traced to its source, and every clue, no matter how faint, was thoroughly investigated. Attorneys for the defense traveled over twenty thousand miles throughout the United States checking on possible evidence. But most of the clues were of little value and a number of them actually spurious. Why men would fake evidence for no other reason than the desire to get into the limelight has never been explained, but lawyers who handle criminal cases are quite familiar with such pests. Although the Alliance attorneys were extremely careful and wary, one Detroit dentist nevertheless succeeded in imposing upon them. He claimed to have cast a bridge including occlusal surfaces of abutments all in one piece, but when presented in court the specimen was found to be a soldered piece and his testimony was entirely discredited.

Among the many clues that were followed, several came from the state of Iowa. At first these clues were rather faint but, upon more thorough investigation, they seemed to converge in one direction. They all led to Dr. B. F. Philbrook of Dennison, Iowa. Dr. Philbrook not only made cast

inlays for his patients but he actually read a paper on the subject at a meeting of several dentists in the county. The story which he told about his invention and how he happened to originate it was about as follows:

In the early nineties, a number of his patients were farmers who had but recently settled on the land. Most of them were quite poor. Some still lived in a corner of their barns, because they could not yet afford to build decent homes for their families. These people found his moderate charges of five or six dollars for a gold crown beyond their reach. He therefore filled many broken down molars with amalgam. But that was before the days of G. V. Black's work. The amalgam alloys had not yet been perfected, and his fillings crumbled under the stress of mastication. One day it occurred to him that a solution of the problem would be to cast all large fillings in some low fusing metal, and then cement them into place. The casting would naturally be stronger, and therefore more permanent. Like other dentists of that time, he was familiar with the casting of aluminum and Watt metal plates, and so he tried the same method for casting his inlays. He fashioned a pattern in the tooth cavity with some pink base-plate wax and embedded it into plaster. When the molds were set he carved out a crucible with his pen knife, split the mold, removed the wax, wired the mold together and then poured some Watt metal into the cavity.

The resulting fillings, however, were useless, because the sprues were larger than the fillings. To overcome this difficulty, he decided to use a wax sprue. A split mold did not prove very satisfactory. Then he had the idea of attaching two wax sprues, one straight and the other at an angle towards the edge of the investment. This enabled him to wash out the wax pattern with hot water completely. It also had another advantage. Since there was no air resistance, the fluid metal would run down the center sprue hole, fill the cavity and up through the opening at the side of the mold.

For awhile this method produced fair results. Then, quite accidentally, while drying the investment on a small flame, he noticed that the wax began to burn and soon was entirely dissipated. This suggested the substitution of dry heat in place of hot water for the wax elimination. But while obviating the need for a side sprue, a new difficulty developed. The confined air within the mold kept the molten metal from running down the cavity. This he finally solved by placing the large end of a small funnel over the top of the mold and blowing upon the metal through the narrow opening. Actually he was casting by air pressure, using the air within his own lungs. Shortly after that he became more ambitious and attempted to cast gold inlays; but here he met another problem.

Low fusing metals remained liquid for some time, and it was possible therefore to blow them down into the mold, but gold congealed too quickly. Undaunted, he continued to experiment and finally hit upon a method of pushing the gold into the mold by pressure, using a pad made from moistened asbestos fibers and applying it directly over the molten gold. Actually, it was the steam generated from the water in the pad that forced the metal down the sprue hole, but Philbrook did not know that.

At first he was very enthusiastic about his invention and read a paper on the subject before the county dental society. His audience, however, was not impressed. The county dentists could see no reason for spending more time in the making of an inlay than a crown and collecting only about half the fee. After a short time, Philbrook himself abandoned the casting method. Plaster of Paris investment and base-plate wax did not produce good inlay margins and besides the dental cement was still very imperfect. The cast fillings were not as permanent as he had expected. Not until 1907 when Taggart demonstrated his process with the special wax, special investment compound, and all the necessary appliances perfected to the last detail did Philbrook start to use inlays in his practice again.

Legally, Philbrook's abandonment of his method did not lessen the value of the prior art. The only question was, however, whether the court would give credence to the story. True, his office records showed that, about 1896, he had inserted several white metal inlays and one gold inlay for his patients, but that was more than twenty years before and not only the fillings but the teeth which carried them had since been lost. Even our present day inlays are seldom that permanent. A few dentists in and around Dennison remembered something about Philbrook's tinkering with castings and some could recall having heard him read a paper on the subject. But it had happened so long ago that their memories regarding details were quite hazy.

Besides the legal phase of the problem, there was also the attitude of the court to be considered. On one side was the plaintiff Taggart, the individual. On the other side opposing him a powerful association numbering more than 7,000 members. Taggart had been reasonable. He had offered them the use of his process for the small sum of fifteen dollars. Now, while they were all making a great deal of money from the invention, he had never received one cent. There was a chance that the judges might be favorably inclined toward Taggart, and, in their sympathy, resolve every doubt in his favor. The courts were not concerned with the ethical aspects of dentistry. If the patents were to be defeated, Philbrook's testimony would have to be

corroborated so thoroughly that the judges would have no choice in making their decision.

The prospect of finding such corroborating evidence did not look promising. Then, in the course of the search, a copy of Philbrook's paper, entitled "Cast Fillings" was discovered accidentally in the dental library of the University of Iowa. This of course was nothing but sheer luck. Probably less than a dozen men had been present at the meeting, at which the paper was read. The proceedings of such small gatherings are practically never published. What prompted the secretary to print those transactions, which covered no more than four ordinary book size pages, or why he thought it necessary to preserve the transactions of that meeting for posterity, is hard to understand. It is equally difficult to explain how it happened that such an insignificant leaflet remained in existence for over twenty years.

But there it was. The evidence was irrefutable. When Philbrook told his story and was followed by several supporting witnesses and his office records, and when finally the leaflet was placed in evidence, Taggart's attorneys were dumbfounded. They were forced to admit that Philbrook had actually cast inlays out of metal from a wax pattern that fitted the cavity. The inlay patents were declared invalid because of a public disclosure made by an obscure dentist in the small town of Dennison, Iowa, nearly a quarter of a century earlier.

The whole story of Taggart's defeat seems to have been composed of a series of lucky accidents. The successful leadership by a group of untried men, the prior anticipation of the method by Philbrook, the inexplicable printing and preservation of his paper, were part of a chain of fortunate circumstances which resulted in a victory for the ethical standards of the dental profession.

To the thoughtful members of the Alliance, however, this victory was not without its sting. Legally, of course, Taggart had no right to a patent monopoly. But it was he who taught the profession to cast inlays, which was without doubt the greatest single contribution to dental progress that had been made by any individual. Yet, in spite of this invaluable service, he was dragged through the courts, his old age embittered by litigation, and he was left to die in poverty, while the members of the profession were earning millions from the method which he alone had popularized. Unfortunately, however, the profession had no choice in the matter. Taggart had taken the wrong position, thus forcing the dental profession to defend its freedom.

Without doubt, Taggart himself was a good deal to blame for his predicament. If he had held back his demonstration until ready to deliver machines in quantities, he could easily have made a sizable fortune. Even after the market was flooded with all types of casting devices a reliable dental equipment manufacturer offered to guarantee him one hundred thousand dollars in royalties for permission to manufacture the machine and market it for seventy-five dollars, but Taggart refused the offer. By that time, Crouse had put the license idea in his mind and he had begun to dream of millions.

The Taggart case was the fourth process patent which the profession had had to fight. Since dentistry became organized eighty odd years ago, each generation was forced to defend itself against the encroachment of its freedom. Twice dentists paid thousands of dollars in royalties, and if it had not been for lucky breaks the profession might have had to pay millions for the right to cast inlays. The officers of the Alliance therefore decided to cap their victory by preventing the recurrence of such litigation in the future. Accordingly, they approached several of the leaders in the American Dental Association with the proposition that organized dentistry should undertake the obligation to defend the profession against attacks by patent holders.

After a number of conferences the House of Delegates of the A.D.A. finally adopted an amendment to its by-laws creating a process patent committee, whose functions were to litigate all process patents, and to prevent the repetition of the Crouse agreement. A clause was added that "no patent on processes shall ever be compromised." The permanent protection of dentistry having been obtained, the Alliance turned its reserve fund ($12,000) over to the American Dental Association and disbanded the organization.

Obviously this does not prevent any one from patenting a method or a process that may be used in the practice of dentistry. But it is a reasonable assumption that few men will care to enforce such patents by entering into a legal contest with the organized profession.

CHAPTER XXXIV

FADS AND FRAUDS IN THE TREATMENT OF PYORRHEA

Pyorrhea alveolaris, the flowing of pus from the alveolar socket, describes the symptoms rather than the disease. Specialists in this field have therefore insisted that the more accurate term, periodontoclasia, be given preference. The public, however, has been familiar with the shorter though unscientific name for many years. Patients and many dentists continue to speak of the disease as pyorrhea. In speech, usage always lends authority.

Pyorrhea, like tooth decay, is a human disease and of equally ancient lineage. The oldest Egyptian manuscripts (3700 B.C.) refer repeatedly to remedies for the strengthening of the gums. Obviously, the inhabitants of the Nile Valley must have suffered from pyorrhea long before these Papyri were written.

Loose teeth and bleeding gums are also frequently mentioned in early Chinese writings, and the Greeks undoubtedly had a name for it. Hippocrates gives several prescriptions for the cure of this condition. Pyorrhea was very common in Rome of the Empire, and alum, nut-gall or urine from an innocent boy were popular mouth-washes used for the relief of bleeding and spongy gums. Celsus (30 B.C.) recommends vinegar or unripe apples, and among the several remedies suggested by that credulous narrator Pliny, was the kindled heel of an ox brought close to the loose teeth, and a mouth wash made by boiling frogs in vinegar. In the medical writings throughout the Middle Ages there is constant reference to loose teeth and bleeding gums. The prescriptions were mostly copied from great Mohammedan physicians like Rhazis or Avicenna, indicating that Arabians, too, suffered from "pink siwak."

Early doctors confined themselves for the most part to the treatment of symptoms. Astringents, therefore, seemed a logical remedy for "tightening or strengthening" of flabby gums. Fauchard thought that pyorrhea was a systemic disease, a "kind of scurvy," the disease with which he had become quite familiar while serving in the French navy, where it was quite prevalent.

Treatment by instrumentation was done quite early in history, since in many cases of bleeding gums the presence of serunal calcules at the necks of the teeth is quite evident, and their removal would seem to be a logical part of the treatment. The shape of Arabian scalers indicates that they were employed for such a purpose.

The first intelligent description of the disease is given by John Hunter, in his book "The Natural History of the Teeth" (1778). Hunter recognized that the disease begins at the edge of the socket, and progresses gradually toward the end of the root. Later Fox (1814) differentiated between the types which showed evidence of pus and those in which there is a slow absorption of the socket without pus.

Coming closer to our own time and our country, the name of John M. Riggs stands out most prominently in connection with the treatment of pyorrhea. Riggs was intended for the ministry, but we are told that the dogma was too much for his analytical mind. And so, he chose dentistry, a more positive profession. Riggs was not a particularly prolific writer, but he must have been a fine operator and a good clinician. Riggs' contributions in this field were recognized by his associates of the Connecticut Valley Dental Association, who passed a resolution in 1867, wherein he was credited with "originating and first publicly describing a method of treatment of inflammation of the gums and alveolar process, or so-called scurvy of the gums." In 1876, the Baltimore Dental College conferred the honorary degree of Doctor of Dental Surgery on Riggs.

In line with the common practice of that time to name a disease or anatomical structure after the man who first described it or developed a valuable treatment, the term "Riggs' Disease" was used in this country for a while, but was replaced in 1877 by "pyorrhea alveolaris" a term that had been used in Europe for some time.

John M. Riggs may also be recalled in connection with the development of general anesthesia. It was Riggs who extracted the molar for Wells, when the latter wanted to test the anesthetic effects of the "Gas" upon himself. Riggs was therefore the first man in the history of the human race to operate on a patient under general anesthetics.

Unlike other branches of dental practice which have reached the specialty rank, such as orthodontia, or oral surgery, periodontology can boast of no great men whose achievements have been outstanding. Next to Dr. Riggs, there is only Younger of California, and his fame rests entirely on the observation that correct treatment is followed by reattachment of the gums through the obliteration of the pocket. A valuable observation perhaps but hardly much of a contribution.

Another man who may be mentioned is C. Carr. His name is very little known excepting among a very few and whatever his contribution in the field of periodontia may have been, it received no recognition, principally because he was an uncouth and ignorant man. Carr's antecedents are unknown excepting that he had come from Texas and had practiced for some time in Colorado Springs. Though a man of no education, he was without doubt an expert mechanic, a fine operator and something of an inventor.

Carr had conceived a system of scalers consisting of three lengths with concave, convex and flat shanks, at the end of which there was a small scraping blade. Each shank was bent on an angle from right to left so that eight of them completed a circle. Altogether the set numbered 148. Besides these instruments, he also developed a special technique for grinding and polishing the teeth. Several famed periodontists took his course and bought his instruments. Later, some of them entered into competition with Carr, teaching others what they learned from him, and selling to their students the same types of scalers which he originated. Whereupon, Carr filed suit against them for infringement.

For some reason which has never been clear, the U. S. Dental Protective Association entered the defense, although many of those familiar with the situation thought that it was an unjustifiable expenditure of professional funds, since it was not a process patent, and the defendents were engaged in the sale of instruments for profit. The courts declared the patents invalid and Carr, discouraged by the outcome of his case, went back to Texas where he died a few years later. The legal decision however did not alter the fact that Carr received a raw deal from some of these "specialists."

Like all men of his type, Carr exaggerated the value of his method. The scraping and polishing of teeth assumed such vast importance in his opinion that he began to think of himself as a "Messiah" of health and a great disciple of Hippocrates. In line with his ideas, when he organized a school for teaching prophylaxis, he called it the "Post-graduate School

of Medicine and Dentistry." Carr claimed that any ailment could be cured by his system of tooth polishing and he actually treated people with advanced cases of arthritis deformans, promising the poor credulous invalids complete cures. Whether Carr really believed these promises, or as others think, he was just a "charlatan," who would not stop at any exaggeration if he thought it helped to sell courses in "prophylaxis," is hard to decide. In any case it is kinder to follow the ancient Roman maxim and "speak of nothing but good of the dead." Despite all criticism, those who took the Carr course admit that they benefited from his instruction.

Riggs and most of his followers looked upon pyorrhea as a local condition, originating in the alveolar bone around the teeth. This opinion, however, was not universally shared. For example, Magitot, writing in 1873, expressed the belief that disturbances of nutrition were the chief etiologic factors, and that the calcareous deposits were of slight importance. Since then a number of other theories were propounded. To cite just a few, the Frenchman Roy thought that the alveolar absorption was a type of premature senility, akin to the falling out of hair. Others insisted that it was an infectious process. Some believed that pyorrhea was hereditary; others that it might be caused by uric acid, etc.

But none of these explanations had any scientific foundation. They were merely speculations and opinions without evidence. The position of those who regarded pyorrhea as purely an oral disease were much more sound. From the practical point of view, theirs was the only pragmatic approach to the problem, since no other treatment excepting the removal of the deposits, followed by a thorough prophylaxis, seemed to give much promise of improvement.

Difference of opinion regarding the causative factors naturally influenced methods of treatment. While some dentists concentrated on instrumentation others attempted to find a cure in some drug or medicament. The fact that a large number of cases did not respond even to the most skillful prophylactic treatment naturally tended to support this attitude. It was these baffling conditions and the search for a remedy that might aid in their treatment which made the dental profession a ready prey to every "charlatan and hare-brained faddist who offered a cure for pyorrhea."

The listing of all the preparations which were sold for this purpose would fill a large volume. Almost without exception, none of them had any merit whatever; some were actually injurious to the gums or teeth. Most of them were compounded by ignorant men who had neither scientific information nor an understanding of the problems involved. Their stock

in trade was the gullibility of the profession. During the last few years, the "Council on Dental Therapeutics" of the American Dental Association has exposed many of the brazen fraudulent claims made by manufacturers of so-called "pyorrhea cures."

Among the various pyorrhea treatments, one that enjoyed rather wide acceptance for a time, was the vapor method, introduced by a New York dentist. This consisted of a modified oxygen vapor injected into the pyorrhea pocket by means of a blunt needle. For some unknown reason, the vapor treatment appealed to the profession. Many dentists paid one hundred dollars for the instruction, and an additional hundred for the tank, valve and other gadgets. Like other pyorrhea remedies, the vapor method had no scientific foundation, excepting perhaps a course in scientific salesmanship, for the "inventors" were certainly excellent salesmen, although rather deficient in their knowledge of pathology and therapeutics.

Two fads—the vaccine and emetine treatments, unlike the vapor method, were honest and sincere efforts. The originators had nothing to sell; their motives were absolutely unselfish. All they might be charged with is muddled thinking or an insufficient grasp of the scientific method of experimentation.

Vaccine never became popular, for few dentists possessed the necessary technique to make a good vaccine. The dental literature, however, was full of the subject for a time. The use of vaccines was obviously based on the theory that pyorrhea was an infectious process, of which there was absolutely no proof. Considering the mixed varieties of organisms which normally inhabit the human mouth, it is hard to understand how any one with even a rudimentary knowledge of immunology could have wandered off on such a tangent.

But the great hoax was emetine! Not that the originators intended to deceive anybody for they themselves actually believed in the treatment. It turned out to be a hoax however, both on the dental and medical professions. Emetine had proved to be almost a specific in amebic dysentery. One day, two laboratory workers observed a large number of these organisms in the mouth of patients suffering from pyorrhea and decided to test the effectiveness of the amebicide in several cases. Just what happened is hard to tell, but it must have appeared to them that following the use of emetine the conditions of the patients' gums showed definite improvement. Apparently afraid that some one else might rob them of their glory, they rushed into print. It was a plain case of drawing conclusions from

insufficient data. They could not have checked their work very thoroughly; otherwise they would never have made such a gross error.

But the idea caught the imagination of the profession. It seemed logical that the discovery of the organisms responsible for the disease and the presence of a specific drug should effect cures. Of course, the source from which the treatment originated lent it validity. It was so very simple! A few injections of emetine into the arm of the patient and the amebae which caused all the trouble would disappear; the patient would be cured. It was wonderful; the very thing for which dentists had been hoping.

Manufacturers immediately realized the commercial possibilities of the product. Emetine ampules were soon made available. Both the medical and dental press devoted much space to the subject; the public, too, became keenly interested. Many people who had believed their teeth were doomed took on new hope.

The enthusiasm was short lived. Emetine, like vaccine or oxygen vapor, had no value whatever. Amebae were also present in healthy mouths. It was only one of many organisms and entirely innocent of parasitic proclivities. Careful investigation readily proved that this drug was no better than the kindled heel of an ox, recommended by Pliny about two thousand years ago. The dental profession had to return to its scalers and polishing instruments.

The rather indiscriminate acceptance of frauds and fads which have been suggested for the cure of pyorrhea is partly explained by the early history of dental education. In many instances this uncritical attitude was more apparent than real. Discouraged by those obscure cases which did not respond to the most painstaking local treatment, the average dentist, in his anxiety to help the patient, would frequently listen to the claims of "cure-venders" against his better judgment in the hope of finding some remedy that would help alleviate this condition which always terminated in the loss of the teeth. The repeated search and the readiness to spend hard earned money and valuable time, in spite of all the failures, is really a tribute to the dental profession's concern for the welfare of those entrusting themselves to its care.

Neither the knife nor the cautery are new in the treatment of pyorrhea. But recent improvements in technique and appliances and a better understanding of traumatic occlusion, have added considerably to results obtained from regular instrumentation. Diet and vitamin deficiency have recently received a great deal of attention, but the discussions have been more ver-

bose than informative. Present knowledge of nutritional factors in connection with oral diseases is extremely limited.

Whether we call it "pyorrhea" or "periodontoclasia" we are forced to admit that the progress of knowledge in this field since the days of Dr. Riggs, about eighty-five years ago, has not been very encouraging. Pyorrhea is as prevalent as ever and like tooth decay, it seems to be related to what we are pleased to call "civilization."

CHAPTER XXXV

THE AGE OF ARTICULATORS

In the long process of evolution, some species of animals have predominated over all others, and the names of these creatures have often been used by biologists to designate certain periods in evolutionary history; as for example the age of the "dinosaurs" or the age of the "flying reptiles." Similarly we may be permitted to name the first three decades of the twentieth century the "age of articulators" to designate that period in dental history when articulators were the dominant subject to engage the attention of the dental profession. In the term articulators, we include various gadgets such as path-finders, guides, face-bows, etc., and the entire paraphernalia which has been advocated by teachers and prosthetic specialists for measuring the movement of the condyle-path.

There seems to be some difference of opinion as to whether Goriat the Frenchman in 1805, or Pfaff the German, fifty years earlier, was the inventor of the first articulator. Except for national pride this point is of scant importance, since the early devices were no better than a barn door hinge. The age of real articulators may be said to have begun in 1840, for it was in that year that Evans patented his appliance, which made some provision for protrusive and lateral movement. Eighteen years later (1858), Bonwill appeared with his anatomical articulator and the theory about the triangle which has since been called by his name. But the profession paid very little attention to Bonwill and the subject lay dormant for nearly forty years.

In 1889 it came to life again and has been very much alive ever since. The following eighteen years were exceedingly fruitful; nine different articulators were placed on the market by as many inventors. In 1907, Snow arrived upon the scene with his "Twentieth Century" articulator and face-bow. After that, the subject was off to a grand start. Three point contact, the condyle path and anatomic articulation became main themes at all dental meetings. Month after month dental publications carried one

or more articles dealing with curves, path-guides and other details in connection with balanced occlusion. Page upon page of dental literature was filled with pictures of heads and profiles enclosed in face-bows, or illustrations of mandibular joints covered with diagrams and triangles. Dental schools began to teach their students how to register the condyle path and how to transfer the measurements to the articulators. State boards soon fell into step and three point contact became one of their examination requirements.

But all this teaching and writing about measuring the elusive wanderings of the condyle had little if any effect on the quality of denture service delivered by the average dentist. Edentulous patients continued to suffer with false teeth which would not stay in place. Indeed, many observers were of the opinion that emphasis on articulation and condyle movement only served to complicate the problem without improving the quality of denture construction. In the enthusiasm for three point contact, the most important subject, impression technique, was almost forgotten, and many experts in recording mandibular movements could not make a set of teeth which a patient might wear with comfort.

There was, of course, a minority which did recognize the importance of impressions and realized that a perfect set of artificial teeth must be built on models which are exact duplicates of the jaws. Among these, the Greene Brothers, Peter and Jacob, of Chillicothe, Mo., must be given a prominent place. The two were probably the first to teach the closed mouth compound impression technique in all of its details. Peter Greene also taught the use of plaster and compound combinations, this method was later developed by Rupert Hall and became known as the "Hall Method." In fact it is believed by some men that the small volume of lectures (220 pages) published by those pioneers in 1910 was the greatest single influence in raising the standard of denture service in this country.

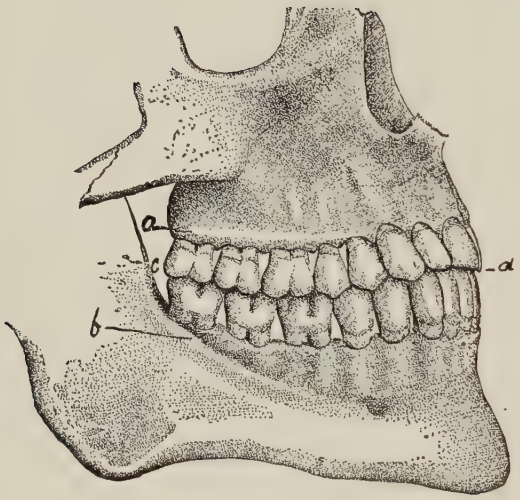
Modeling compound was invented by Charles Stent, an Englishman, in 1856. But it did not come into competition with plaster until perfected by the Greene Brothers about 1900. Without passing judgment on priority claims, it is a fact that, following the Greene Brothers, a number of men began giving courses in compound impression technique all over the country, particularly in the large cities. About the same time Gysi brought out his two articulators; one adaptable for the specialist and the simplex for the ordinary dentist. These were supposed to be the final answer to the problems of articulation. Through the interest of a large tooth manufacturer, the Gysi system was widely publicized, and many men included Gysi's

theory in their courses on impression technique. Compound, however, did not become popular as an impression material because its use was time consuming and too involved. It was a complicated procedure for doing a simple operation. Nevertheless these courses served a very useful purpose. They created a keen interest in the subject, so that the profession was ready for the next step; the Hall technique of plaster and compound combination. This was a rapid and efficient method and with some variation it has remained the accepted technic for impression taking.

But discussion on articulators continued and the dental profession listened attentively to various authorities. Most listeners did not quite understand the meaning of the diagrams and graphs, but they kept on trying to follow the latest pronouncements on the subject to the best of their ability. The average dentist is a trusting fellow. He was sure the authorities must be right, and whenever finances permitted he purchased another of the "absolutely-most-scientific" articulators and again began to measure the condyle movement with the discarded face-bow.

Then, at the height of the popularity of the Hall technique, when the modeling compound and plaster impression combination was receiving the widest attention, a well known mid-western clinician and plate specialist, a man who for years had talked learnedly about three point contact and condyle measurements, made a startling disclosure during a discussion of the Hall impression method. He told his audience how, through oversight, he had mounted two sets of models according to measurements which belonged to other patients, and very much to his surprise, found that the error made no difference. Both cases fitted perfectly. Since then, he had made a number of experiments with similar results. Therefore, he gave up using a face-bow. He admitted frankly that all his previous teachings were absolutely wrong and that the face-bow was of no value. It has not been recorded that this man ever explained why he did not put his theory to such a test before he began to teach it. It would have been a simple matter. Perhaps he was in the same position as another well known teacher whose name is familiar on the North American continent wherever dentistry is practiced. In a discussion of a paper presented by Dr. Hall at a state dental convention, he made this astounding statement, "To be frank, I never quite understood what this three point contact was all about, but there was nothing else to teach, so I taught three point contact."

In view of such admissions by authorities, it might have been expected that the further multiplication of articulators would have been halted. Instead, after having popularized his simple and efficient impression technique,



NORMAL OCCLUSION

STRENGTH OF HUMAN JAW

MEASURED WITH

THE GNATHODYNAMOMETER

AVERAGE STRENGTH OF BITE,

BACK TEETH

8 years	35 lbs
12 "	75 "
18 "	140 "
Adults	175 "
Maximum record young adult	325 "

THE FORCE REQUIRED

TO CHEW VARIOUS FOODS

MEASURED WITH

THE PHAGODYNAMOMETER

Cold boiled tongue	15 to 20 lbs
Pork chops, loin	20 to 25 "
Roast pork	30 to 35 "
Roast veal	30 to 35 "
Boiled corn beef	30 to 35 "
Mutton chops	30 to 40 "
Broiled ham	40 to 60 "
Beef steak tenderloin	35 to 40 "
Beef steak, chuck	40 to 60 "
Beef steak, "boarding house"	60 to 80 "

Hall brought out an articulator of his own. At the same time he proceeded to advocate the use of teeth with very deep cusps as the only method to enable denture wearing patients to masticate their food efficiently. It was a splendid theory. There was only one thing wrong with it. It would not work. The deep cusps would dislodge the plates every time the patient attempted to chew. Those who followed Hall's suggestion simply had to spend additional time to grind off the long overhanging cusps.

Hall's articulator came on the market about 1915 and was followed by Munson, Needles and Hanau's articulators. All told, more than twenty-five different apparatuses for setting up teeth were advocated at one time or another since 1889 "as the most scientific" instruments for reproducing condyle movement.

Realizing that deep cusps were impractical, Hall unhesitatingly went to the opposite extreme and began to advocate flat teeth without any cusps and the use of the old plain hinge articulator. Other "authorities" were chagrined at Hall's complete reversal of opinion. Some accused him of "turning the clock back seventy years." The controversy became acrimonious. But Hall, undaunted, stood his ground and in 1930 we find him insisting that "the new trubyte articulator which carries Gysi's name and endorsement is incapable of recording these relations, nor are any other articulators now on the market (such as Snow, Wadsworth and Hanau) capable of doing so." Hall even threatened to call in the government Bureau of Standards, as an unbiased body to make a study of the subject, and finally put a stop to the controversy. Apparently, however, nothing has happened since and the arguments are still going strong. At present, the Monson and Hanau articulators each have their adherents and defenders, but the latter is probably the more popular. Hall is now talking tri-dimensional occlusion for teeth with cusps and two-dimensional occlusion for teeth without cusps.

The average dentist has finally lost interest in the polemics which, it must be admitted, have not been altogether in vain, since they stimulated keen interest in better denture service. Face-bows are now accumulating rust, but the profession at large has learned the art of taking good impressions. Most of them, when setting up artificial teeth, aim at nothing more than simple balance and the demands of esthetics. This may not be the ideal, but until authorities have agreed amongst themselves there is nothing else they can do.

CHAPTER XXXVI

DENTISTRY BECOMES A BUSINESS

The business side of dentistry was a tabooed subject until about twenty-five years ago. Most dentists considered it beneath their dignity to discuss the problem of costs, overhead and fees. Dental schools feared to teach the economics of practice management because it might "commercialize" the profession. If, occasionally, some member of a senior class developed an interest in how much to charge for an amalgam filling or a gold crown, the professor would usually frown on the questioner and tell him that if he became a good dentist and rendered good service, he need not worry about such details. Fees would take care of themselves.

This was true in some cases. A few competent dentists seemed to possess sufficient business acumen to run their practices profitably. A few men knew intuitively how to charge adequate fees, keep down their overhead expenses, and collect their bills promptly. But the majority were floundering. Bookkeeping was an unknown art among dentists. Most of them could not tell definitely what fraction of their gross receipts went for overhead costs and how much remained as their net yearly income. Though working long hours, evenings and, frequently, Sunday mornings, the vast majority were barely able to make both ends meet.

As the twentieth century progressed, the economic condition of the profession as a group became worse. In large measure, this was due to the gap between prevailing dental fees and increase in the cost of living. Though costs governed the price of most commodities, charges for dental services were usually controlled by fear. The average dentist kept his fees low because he was afraid of being underbid by a neighboring competitor. That fear was often justified, since few dentists had any idea how to determine the proper fees for a given operation; the patient could always find some dentist who would charge less.

Another equally important factor affecting the dentist's income was

the change in methods of practice, which resulted from the introduction of the inlay process, and the recognition of focal infection as a serious menace to health. These two great discoveries which revolutionized dentistry, although differing widely in their application, had one aspect in common. They increased the demand upon the dentist's skill and forced him to exercise greater care in his operations. Accurately fitting inlays required more painstaking effort than shell crowns and the treatment of root canals under aseptic control took more time than the slipshod method used before Hunter's attack on "American Dentistry."

Dentistry as a whole became more exacting and more time consuming. The quality of dental service improved greatly, but the rank and file of the profession did not collect fees commensurate with the time and effort which the new methods of practice required. The income of the average dentist was generally less than that of men in other callings, who were no better trained, whose responsibility was no greater and who usually worked fewer hours under less nervous tension.

Shortly before the war this unfavorable economic condition began to receive some attention from members of the profession. A number of articles on the business side of dentistry began to appear in dental journals. Some writers insisted that it was quixotic for a dentist to disregard the financial aspect of his practice because of traditions inherited from a remote past. They suggested that, since as a means of making a living dentistry was a business, more thought should be given to the business side of practice management.

But the profession was not alone in its difficulties. Dental equipment manufacturers were faced with a similar problem. Following the nineteenth century, there had been a steady improvement in the efficiency of chairs, cabinets and engines. But sales remained unsatisfactory, for the simple reason that the majority of dentists were unable to buy the new and more expensive equipment; they could not afford it. The only solution to the manufacturers' difficulties, therefore, was to widen their market by convincing the profession that new equipment and new furnishings were not an expense but a paying investment, because a modernized office would bring more patients and help raise fees.

Accordingly, equipment dealers and their employees became architects, interior decorators, efficiency experts and sales psychologists. The average dentist, always a trusting fellow, accepted them at their word. Besides, he was hard pressed, and their economic patter sounded reasonable. Thus began the era of two chair offices and the sterilizing room. The double

equipment plan was based on the idea of efficiency. Dentists were made to believe that if they ran from one chair to another, and ran fast enough without stopping or resting between patients, their incomes would increase. This was true, of course, provided their physical endurance would last, and provided they had a sufficient number of patients to constantly fill both chairs. In most cases, however, the double office was fitted up on future expectations. More often, besides paying for two sets of equipment, dentists were burdened with additional rent for space which they seldom used. The two chair office was generally profitable for the equipment dealer, but not always for the dentist.

But the great inspiration of those "business building" experts was the special glass enclosed sterilizing room, always located to attract the immediate attention of everyone who entered the office. Of course, no patient suspected his dentist of criminal negligence. He did not ask for visual evidence that the instruments used in his mouth had been sterilized. In fact this elaborate outfit, with its shining boilers and shimmering glass jars was seldom used; for the small sterilizer in the laboratory was more convenient. The sole purpose of the sterilizing room was to impress patients. It was part of the sales psychology; the foundation of equipment distributors' arguments to help sales.

Yet we cannot blame the equipment people very much. If they exaggerated the practice building value of mahogany cabinets and engine units, they merely followed the methods commonly employed in the business world. Furthermore we must admit that although serving their own interest, they have, within certain limits, also helped the dentist, since a well equipped office is undoubtedly the first requisite to the establishment of a successful dental practice.

Much less, however, may be said for the cost accountants, auditors and other "business builders," who, taking their cue from the dealers in equipments, and seeing a chance for easy money, began to sell courses in office management. These courses nearly always included elaborate forms and bookkeeping systems. Most of the systems were far too complicated and entirely unnecessary for the average practitioners' small yearly income of a few thousand dollars. But the nicely bound loose-leaf records gave the dentist a feeling of being ultra efficient and a sort of kinship with "big business."

The common method employed by all those economic "experts" for arriving at a figure upon which to base dental fees was to start with capitalizing the time and money spent by the dentist acquiring his education.

Usually this figure was set at twenty thousand dollars. Interest on that sum was the first item set down as part of the dentist's overhead expenses. We may well wonder what an employer would have answered to an engineer applying for a position if the applicant insisted on being paid a fixed return upon his investment in education, besides a salary for his services. Still it was a remarkable plan for by the mere writing of the numeral 2 in front of four zeros, the dentist would immediately come into possession of twenty thousand dollars and could at once begin to collect six per cent on the amount, or twelve hundred dollars per annum; provided, of course, he could get patients to pay it.

By adding rent, cost of materials, amortization on equipment and other incidental expenses to the twelve hundred dollars, plus a reasonable remuneration for the dentist's time, most authorities arrived at the conclusion that six dollars per hour must be the least which he should charge. This introduced the time clock, a new and previously unknown instrument in dental offices. The practice of charting the time consumed on every operation was advocated as the only right method for arriving at a proper fee. Many dentists began to charge for their services by the hour, like plumbers and other mechanics and the profession was well on its way to becoming eligible for membership in a labor federation.

Six dollars per hour was, of course, the minimum. The maximum was left to the dentist's conscience or the gullibility of the patient and there was no shortage of gullible people during the "new era" when everybody was playing the stock market and hoping to get rich quickly without effort or labor.

While the majority continued to practice their profession as usual, a minority became high pressure super-salesmen, basing their charges not on the fair value of their services but on what the traffic would bear. It ceased to be a question as to how much the service was reasonably worth, but what the patients could be inveigled into paying. There were rumors of fees running into four figures, most of them probably inaccurate. But a number of dentists caught the fever of "big business" and began to join expensive clubs and associate with people of large incomes, in the hope of getting rich patients who could be charged big fees. The few who succeeded were looked upon with envy by their less capable imitators, who just about managed to break even or were forced into debt while trying to keep up with their wealthy acquaintances.

And then came the depression. One might be tempted to say "fortunately" but the tragedy of the last few years is still too fresh in our mem-

ories. Patients stopped coming into offices and dental incomes dwindled. Many successful men, who had been occupying large suites of offices, had to dispose of their extra equipment and cut down the space, because they could not afford to pay the rent. "The big fee" chargers suffered most, since the class which furnished the largest portion of their clientele was the hardest hit during the financial crash. Even those who could still pay fair fees sought dentists that were known to be moderate in their prices.

The depression, however, had its chastening effect. Hard times helped some members of the profession to regain their equilibrium. They began to realize that besides being a business, dentistry is essentially a profession, and therefore methods perfectly legitimate in the commercial world cannot be applied in dental practice; certainly not if the interest of the patient is to receive proper consideration. Most of them are now reconciled to the fact that it is not possible to amass a fortune in the practice of dentistry, but that the intelligent and skillful operator can, and often does find other compensations, such as the satisfaction from work well done and the appreciation of those whom he serves. These, though intangible, are nevertheless of inestimable value.

CHAPTER XXXVII

DENTAL ECONOMICS

During the years when the sales psychologists and business builders were busy selling the dental profession bookkeeping systems and time clocks, and while some dentists were boasting about their big fees, organized dentistry did not remain altogether idle. Thoughtful dentists everywhere realized that though a few individuals could improve their incomes by raising fees, or might perhaps increase their clientele through the installation of new equipment, this was no solution for the majority; that the unfavorable economic condition of the rank and file was not an individual but a group problem.

The main difficulty of the average dentist was twofold. Firstly, lack of patients and secondly, the reluctance of most people to spend sufficient money for the care of their teeth. The ordinary person prefers buying gasoline or admission to the movies rather than dentistry. Young working women, although very much concerned about the condition of their front teeth, often neglected the molars and spent the difference for hats, gloves or other finery.

The recognition of this situation directed the attention of the dental profession toward a more thorough study of the problem and most local societies of any size, state societies, and the American Dental Association appointed committees on dental economics. Papers and discussions dealing with the business aspects of dental practice became popular at all dental gatherings. Indeed, no large meeting was considered complete unless a special session was devoted to this subject, but the practical value of all the studies and discussions was almost nil. Except for a few suggestions on such details as the setting of fees in advance, the use of samples to demonstrate the services recommended and the charging of broken appointments or matters of a similar nature, the benefits which the profession derived from such lectures and essays on economics were negligible.

The only value of these committees was to call the attention of the dental profession to certain facts regarding the use which the American people make of their income and the way the average person spends his or her money. For example, the national expenditure for sweets is more than for dentistry. Our women spend twice as much on cosmetics as they do on their teeth. These and similar facts brought home to the profession the fact that dentists, like other purveyors of services or commodities, are competing for a share of the consumer's dollar. A possible solution to the problem of increasing the collective income of the profession was, therefore, to join in the scramble with the rest of them. In other words, the dentist should begin to tell the people about the value of his services, and point out the desirability of choosing dentistry instead of other commodities or services.

This was the idea back of the educational publicity which became one of the most prominent activities of organized dentistry all over the country. At every opportunity, through print, lectures and the radio, the dental profession began to spread its message on oral health and on the dangers of focal infection. A great deal of such publicity was obtained without cost, but in some cases societies were not averse to paying for space or broadcasting time.

A number of men frowned on this laity education. They insisted that the so-called educational publicity was simply an indirect form of advertising, but the rank and file did not share their view. They believed that by disseminating dental information among the people, the profession was actually rendering a very valuable public service and if, incidentally, the demand for dentistry was stimulated and more patients came into dental offices thereby increasing the income of individual dentists, that was perfectly legitimate and not open to criticism.

Just how much the profession really gained from the campaign of education is hard to estimate. We know, of course, that teachers and college professors spend more money for dentistry in proportion to their incomes than any other group of our population. If this indicates a relationship between education and the appreciation of good teeth, then it may have been a reasonable assumption that a more widespread knowledge of the subject among the public in general would broaden the demand for dental services and the income of the average dentist would increase.

However, opinions varied. Some claimed that buying power, not education, was the principal factor in determining the care which most people gave to their teeth. To prove their argument they pointed out that the

poorer classes visited dentists much less often than the well-to-do, while families with incomes in the higher brackets seldom, if ever, neglected their mouths.

The experience of the Dental Relief Clinic in Chicago seemed to support this contention. Of the 100,000 teeth extracted in that clinic during one year from the mouths of about twenty-five thousand patients, more than fifty per cent showed evidence of previous dental work, such as fillings and crowns. Apparently a large number of these people who, when employed, belonged to the low income groups, had nevertheless spent a fraction of their small earnings on their teeth. This supported the contention that lack of means rather than lack of knowledge keeps the majority away from dental offices. What our people need is not more education but more money.

However, contrarily, there are some recent figures which show that people with incomes of two thousand dollars and under spent 3% for health services and 7% for automobiles, whereas those who belong in the two-to-three thousand dollar group increased their expenditure for automobiles to 17% and for teeth to only 5%. This obviously would indicate the possibilities of more education.

An important phase of such publicity was the examination of children's teeth at the schools. Everywhere throughout the country, dentists examined and charted the mouths of thousands of children. With rare exceptions, most of them gave their valuable time without pay. In fact, if more young patients came to the offices the increase in the dentist's business usually represented a loss. The time spent in proportion to the average fee collected makes the care of children's teeth almost unprofitable. Whatever suspicion of selfish motive may have been caused by the attempt to educate the adult population, the school examinations were definitely an unselfish effort. Yet even this did not go unchallenged.

A number of dentists believed that, while an intelligent minority may appreciate information about the condition of their children's teeth, the majority would probably misunderstand the motives. They might look upon school examinations as a scheme to increase the sales of dentistry. And why not! Free services for the purpose of stimulating business is common practice in the commercial world; for example, radio stores are always glad to test tubes free of charge in the hope of increasing the demand for new tubes. Most people are suspicious when they are offered something for nothing. Furthermore, the fees which the dentist was frequently obliged to charge to repair badly neglected mouths of some of the

children often fostered that suspicion. The ordinary layman finds it difficult to understand why filling children's teeth should be just as expensive as similar operations for adults.

A more serious objection, however, came from outside the profession; from workers in the social service field, and others familiar with conditions among the lower wage earning groups. They questioned the wisdom of creating a need without providing the means for taking care of that need. They could see no utility in the marked dental charts which the children brought home from school, when there was no place where those teeth could be fixed at fees which the parents of such children could afford to pay. In their opinion, informing a poor working man's wife about the condition of her children's teeth when the necessary cost was beyond her means, was only adding to the tragedy of poverty.

This criticism was not entirely valid, for in some of the larger cities local dentists did establish clinics for the care of indigent children in co-operation with the board of education or the health department. These clinics operated more or less successfully until the onset of the depression, when most of them were closed for lack of funds. At the present time, very few communities provide dental service for their under-privileged children. Unfortunately, it is one of the inadequacies of the dental profession that while the poor may obtain at least a minimum of medical attention in dispensaries or teaching clinics, they have absolutely no access to dental services of any kind.

At present it appears as though this situation will continue indefinitely. Since the arrival of the "new deal" upon the political scene, the average dentist has developed a fear, which is almost a phobia, of clinics or any other institutions in which the state takes an active interest. Considering our political government and the type of men who run our cities and states, this attitude is amply justified. And yet, how long can the profession continue to confine its services to not more than a fraction of our population?

CHAPTER XXXVIII

THE MODERN SISYPHUS

In the ancient city of Corinth, there was told a story about a former inhabitant, Sisyphus, a very clever fellow who overreached himself and offended the Gods. As punishment for his great sin, the Gods decreed that he should forever roll a huge stone uphill, and, that when the stone was almost at the top it should roll down again, so that his job would remain forever unfinished.

This story suggests the modern dentist. He too, like Sisyphus, is never able to catch up with his task. In spite of all his efforts, patients keep returning with more cavities, more decay and more teeth which must be filled, crowned or extracted.

Several years ago some members of the profession began searching for the causes of tooth decay, hoping that such a discovery would change the dental history of the average person, so that like other creatures he might take his teeth to the grave.

One of the outstanding investigators was Dr. W. D. Miller, whose research was carried on during the latter part of the nineteenth century. Miller had observed that the outer covering of the tooth, glass-like enamel, offers perfect protection against the organisms of decay. Only when the enamel has been dissolved at some point are teeth-destroying germs able to attack the dentin and form a cavity. Based upon this observation, Miller set himself the task of finding out how the enamel-destruction starts and how the dissolving agents operate. His conclusions, after some years of investigation were: that certain organisms produce lactic acid from the fermenting food particles around the teeth and that this acid dissolves the enamel, starting tooth decay. Later the observation was made that the gelatinous plaques which form in some mouths confine the lactic acid, preventing dilution and keeping it in contact with the tooth surface. Miller, however, did not explain why the teeth of some people remain unaffected

by the acid although remnants of food particles are present in all mouths.

But the dental profession, accepting the acid theory uncritically, began to take certain measures for the prevention of decay in line with Miller's exposition. Thus was developed the slogan: "A clean tooth never decays." (Slogans are modern word charms—excellent media for the dissemination of half truths.) The profession, accordingly, started a campaign to save teeth by means of the toothbrush. Dental societies vied with each other in organizing oral hygiene publicity and toothbrush drills in schools, and other institutions. "Brush your teeth twice a day," became the credo of most dentists. Patients were told that the brush was the best remedy for the prevention of decay and for keeping their gums in a healthy condition.

When improvement was dubious, instead of being discouraged, the profession redoubled its efforts and urged more vigorous brushing. Some suggested that failure was due to faulty technique; that only by a special method of brushing could the desired results be achieved. An enthusiastic missionary from Iowa traveled from one dental society to another, giving demonstrations of his particular technique of brushing up and down. Another equally positive chap insisted that circular motion alone would save the teeth.

Different types of toothbrushes also had their advocates. Some dentists preferred them large; others small. The shape of the bristles and the stiffness of the handle were thought to be of utmost importance. Manufacturers were, of course, ready to accommodate, and soon the market provided every type of brush imaginable.

To enhance the effectiveness of the brush, special medicinal agents were incorporated into powders and pastes which, it was hoped, would neutralize the acid or kill the organisms of decay. This started the great toothpaste industry. Each maker of toothpaste devoted himself to a different phase of the problem; some to the removal of the "film" (plaques), others to the "danger-line" and others to "teeth hard to bryten." Finding the "dental cripple" fairly well taken care of, one manufacturer made it his special business to help the "four out of five who have pyorrhea." They were all eager to help save the teeth of the American people. Incidentally, of course, the manufacturers made millions, radio performers received fat contracts, and soft voiced announcers earned handsome salaries. Dentists, too, were happy, since they believed patients were being benefited.

At last the American people became toothbrush conscious. Without exception, every individual in the upper and middle classes used a tooth-

brush and some kind of paste or powder. If clean teeth never decayed and brushing kept them clean, the dental profession should have found a decided decrease in its clientele but that did not happen. The number of patients did not seem to diminish. The up and down brushing method, or the circular motions made little or no difference apparently. Teeth decayed just as rapidly whether they used paste or "did as the dentist does"; used powder. Cavities continued to form and "four out of five" had just as much gum disease as ever.

The dental profession, of course, had drawn unwarranted conclusions from Miller's findings. Brushed teeth were not always immune. Dental preparations have not fulfilled the claims made for them. The slogan, "a clean tooth will never decay," was not true. Most intelligent dentists began to hesitate to recommend any special pastes or powders. Finally, they realized that nothing can be incorporated in a dental preparation which, coming in contact with the teeth for a couple of minutes twice a day, will stop the constantly operating causes of decay. Though some still insist that brushing is helpful, few consider it a panacea.

The failure of the toothbrush to prevent decay did not really discredit Miller's theory. It simply proved that a brush cannot be depended upon to remove all of the food debris. In its enthusiasm, the profession had overlooked the fact that by far the greater number of cavities starts between the teeth and in the grooves and fissures on the occlusal surfaces. If the fermenting starch and sugar particles were responsible, a brush could never reach those areas.

The recognition of this turned the attention of the dentist to diet and its relation to the prevention of decay. Many observers had noticed that the people who live on the fringes of civilization, like the natives of Alaska, parts of Asia, and even some isolated sections of Europe, had very little trouble with their teeth. Their food, of course, differed according to the location which they inhabited, but it had one quality in common. It was hard and coarse, requiring vigorous chewing. Several investigators concluded that our gum and tooth diseases were the result of the refined and predigested foods which we eat, some of it so soft that chewing is almost unnecessary. Fibrous and hard foods, they claimed, would clean the teeth far better than any toothbrush, and, incidentally, stimulate the circulation in the gums, thus preventing both decay and pyorrhea. In short, we could eat ourselves into dental health by imitating the dietary habits of the less civilized groups. For a while hard fibrous and raw food fads found considerable support among many dentists. Then, some experiments con-

ducted by S. M. Babcock at the Wisconsin Experimental Stations in 1906 turned the thoughts of the dental profession into new channels regarding problems of diet and its relation to dental health.

The object of Babcock's experiment was to "determine whether rations for cattle so made up as to be alike as far as could be determined by chemical analysis, but derived each from a single plant, could be of equal value for growth and the maintenance of vigor." Oats, corn and wheat were always considered excellent fodder. Usually they were fed mixed. In most cases, the cattle thrived. If not, it was considered a visitation of providence, which one bore with resignation, and if the young were born vigorous and the herd multiplied rapidly, one was thankful to the Almighty for the good fortune. Cattle fodder was just food that contained proteins and carbohydrates, the two necessary materials for building tissues and supplying energy. It never occured to any farmer or cattle raiser that there might be some radical differences in fodders; differences not necessarily subject to chemical analysis but of tremendous importance to life and health.

Babcock started with young heifers of about the same age and size. One group was fed the whole wheat plant, grain and straw. Another group, the whole oat-plant, a third, cornstalk and cob and a fourth, equal quantities of all three. After about one year of this feeding, the wheat eating group looked gaunt and shaggy, while those that had been restricted to the corn diet were sleek and fat. The other two remained somewhere in between the corn-fed and the wheat-fed groups. But the most striking difference appeared in the reproduction records of these animals. The young of the corn-fed were born vigorous and of normal size; they developed normally. The calves of the wheat-fed mothers were only about half the normal weight, and, when not still-born, died within a few hours. Calves of the other two groups, although normal in size, did not survive for more than a few days.

This was a strange result indeed. Apparently food could be sufficient and yet inadequate for normal function. These findings were the foundation of the "newer knowledge of nutrition," and recognition of the existence of a mysterious substance without which no diet is adequate—"vitamins." The Wisconsin experiment focused the attention of the dental profession on the influence of the vitamins, as a possible factor determining the condition of the teeth. Some investigators obtained results on rats and guinea-pigs which were rather promising. They could produce decay or pyorrhea almost at will on laboratory animals by the manipulation of their diet.

At last it seemed that real progress was being made. If findings in the laboratory might be applied to humans, then the age-old problem of bad teeth was nearing solution. There was, however, one serious difficulty. Authorities did not seem to agree among themselves. One group claimed that dental diseases were altogether a bacteriological problem and that immunity depended entirely on the saliva. For this reason they advocated large quantities of orange juice and other foods rich in vitamin "C" as the best method for developing those properties in the saliva which would inhibit the growth of organisms of tooth decay. Another group, with equal emphasis, insisted that the hardness of the tooth was the deciding factor. They believed that dental health could be maintained independently of the condition of the saliva secreted. Their theory was that a diet in which calcium and phosphorus predominated, with the addition of vitamin "D," would build teeth so hard that they would resist the micro-organisms of decay which inhabit the human mouth.

During the height of this controversy, an experiment reported in 1932 added still further to the confusion. Small laboratory animals are usually fed on pieces of food which they can normally handle. No one had suspected that a change in the size of the chunks might influence the results of a feeding test. But that was exactly what happened. In one laboratory several rats were fed on a standard diet which had previously been found to be adequate, and on which these animals were known not to develop caries. Surprisingly enough, tooth decay occurred, apparently as a result of the coarsely ground food. This was substantiated several times, and, of course, practically negated all previous experiments in which the fineness of the food particles had not been taken into consideration. All hypotheses and speculations regarding vitamins and minerals and their relation to dental health were seriously questioned.

Another attempt to solve the dental problem was a study of oral conditions and diets of less civilized groups, in different parts of the world which are known to be almost free from cavities or gum diseases. It was thought that if we could determine what food elements were responsible for favorable dental conditions present in their mouth, the information might be applied to relieve the dental ills of our own population. This appeared as a very practical approach to the problem. Unfortunately, the subject is more complicated than it would seem for we have seen how a simple matter like changing the fineness of the food may influence the condition of the teeth. Who knows what other factors besides diet might be responsible for the good dental health of the simpler-living peoples? Rather late nursing,

time spent out-doors, the simple life itself may be contributing factors.

As a matter of fact, there is hardly another group of people which consumes the abundance and variety of food served on the tables of the average well-to-do American family. Nowhere are fresh meats, vegetables and fruits eaten in such quantities during all seasons of the year, as in the United States. If vitamins "C" and "D" are all-important, the inhabitants of California and Florida, where citrous fruits grow in profusion, or those of the state of Wisconsin which predominates in the production of dairy products (a rich source of vitamin "D") should need but few dentists. The oddly favorable environment ought to affect the teeth of the inhabitants. We know, of course, that such is not the case. Decay is just as prevalent in Florida as in New York and the inhabitants of Milwaukee have no less pyorrhea than the bean eaters of Boston. Evidently, there are other causes besides a deficiency of vitamins or minerals, in the menus of our upper classes, which are responsible for their oral manifestations.

It was probably this thought that directed the rather interesting experiments organized at the University of Michigan a short while ago. Three different nutritional studies, with relation to decay, were conducted for the purpose of determining what effect (if any) sugar may have on an otherwise adequate diet. The large quantities of sugar which we consume daily is perhaps the most characteristic difference between our diet and that of the more simpler living peoples, who are comparatively free from dental troubles. The most arresting study was one that dealt with an orphanage group of one hundred and sixty-nine children. The following is a quotation from a recently published report, "A careful analysis of the diet of these children which had been fairly uniform throughout the period of observation showed that it did not meet with standard requirements for adequate nutrition. It was below the minimum standard requirements for calories and below the recommended standard in calcium, phosphorus, protein and certain vitamins. It contained little milk and no butter, a small amount of meat was served daily, no oranges were available except at Christmas time, but a variety of vegetables were provided throughout the year, some of which were fed raw. Dessert consisted of raw apples, cookies were served once a week and a sweet dessert was available on Sunday. Of the total caloric intake from 40 to 45% was in the form of starch and cereals. No candy was allowed the children at any time. Only a minimum amount of sugar was used in the sweetening of food and no sugar was placed on the table."

Seventy to eighty per cent of these children were entirely free from

DR. WILLIAM J. GIES

William J. Gies, B.S., M.S., Sc.D., Ph.D., LL.D., F.A.C.D. was born in Reistertown, Maryland in 1872.

Dr. Gies' professional education was directed toward the field of chemistry, and he has practically since 1895 been a prominent figure in the chemical educational world. He has served Columbia University successively in the capacities of Instructor in Physiological Chemistry, Adjunct Professor and Professor of Biological Chemistry since 1907. Through his teaching relation with chemistry and medicine he became interested in dental research, and has contributed most valuable studies on saliva in its relation to dental caries. Dr. Gies' chemical studies of dental conditions led him to an intense interest in dental education and practice, in which he has played a most conspicuous part since 1919, when he became directing Editor of the *Journal of Dental Research,* which position he still holds.

His interest in dental education was manifested through his association with the Dental Educational Council of America, and he was instrumental in inducing the Carnegie Foundation to conduct a survey of dental education similar to that which had been made in medicine. Dr. Gies was placed in charge of the survey by the Carnegie Foundation, and the valiant work which he did resulted in nearly every dental school becoming associated with universities.

DR. LUCY B. HOBBS

Dr. Lucy B. Hobbs was the first woman graduate of a dental college in the world. She was the first woman elected to membership of an organized dental society. Member of the Woman's Advisory Council, World's Columbian Dental Congress. She practiced dentistry for nearly sixty years.

decay and not more than six per cent suffered from any dental diseases at all during the period of observation, which lasted from one to four years. Of course, it would not be safe to express a definite opinion regarding the effect of sugar from this single survey. Just how and to what extent sugar operates in causing dental diseases (if it does) cannot even be guessed. But it is well to recall the havoc played in the health and function of cattle when wheat and oats were added to the ideal fodder,—corn. Perhaps the large quantities of sugar consumed in the United States (100 lbs. per capita) is responsible for disturbances in the metabolism which is reflected in the condition of the teeth. All this, of course, is merely conjecture.

More interesting even than the Michigan experiment is a recent investigation conducted by Dr. Adolph Roos of Basle, Switzerland, in the Goms Valley, situated at the head waters of the Rhone. From time immemorial and until the end of the last century, the only access to this valley was through several trails running across the mountain passes at an altitude of twelve to fourteen thousand feet.

Such isolation naturally influenced the dietary habits of the people who now number about four thousand, limiting them to those foods which their location provides; several grains, with the exception of wheat which does not grow in the valley, legumes such as beans and peas, root tubers like carrots and beets and milk products. But no sugar. Toothbrushes are unknown and dentists non-existent. Bread is their staple diet. They make it of the ground whole rye kernel. It is customarily baked about three times a year and it becomes very hard and dry, requiring a great deal of chewing force.

Dr. Roos examined approximately eight hundred children. He found the percentage of decayed teeth to vary from six per cent in the less accessible villages to nineteen per cent in those closer to the highway. The children who lived near the mouth of the valley and the railroad had as many decayed teeth as average city children. From these observations, Dr. Roos concluded that "the further up the valley a village is situated and the more the population depends on its home grown food supply, the better are the dental conditions."

It has been suggested that the low incidence of caries in the Goms Valley was due to the absence of sugar in the diet which would give additional support to the Michigan findings. Such an assumption, however, is unwarranted for there are several other factors in the lives of those people which could explain their unusually good teeth. For example, the exclusive use of rye instead of wheat bread or some special hereditary characteristics

resulting from close inbreeding which was fostered by the isolation. Of course, we have no evidence of any connection between the consumption of wheat flour and tooth decay. Still, if wheat is inadequate food for cattle is it not just possible that humans also are affected unfavorably when they eat the products of this grain in large quantities. Wheat bread is the staple diet of all Western peoples among whom caries is most rampant. Similarly, although the hereditary factor in oral health is usually discounted, there is no proof that a group endowed with special immunity to tooth decay could not, through close inbreeding, transmit this attribute to its offspring. The detergent action of their peculiar bread may also have some influence since the required force of mastication undoubtedly stimulates the gums and polishes the enamel better than can be done with a toothbrush.

In short, though the accumulated facts seem to indicate, quite definitely, the existence of a relationship between diet and dental diseases, what that relationship is, and how it operates in determining immunity or susceptibility, is still very obscure.

CHAPTER XXXIX

WOMEN IN DENTISTRY

In the *Dental Times* of July 1865, one of the editors, Dr. George T. Barker, asked the question "Dental surgery—should females practice?" Then he answered his own question "that the very form and structure of woman unfits her for its duties." After elaborating his opinion at some length he concludes in the manner of his great-grandfather Adam by throwing the blame on the Creator, "that an all-wise providence did not fit woman for the great physical effort which the practice of dentistry requires." The eminent doctor merely expressed the prevailing and age old opinion of woman's inferiority, shared by most males in the past, and by many even today.

The first woman to establish herself in dental practice in this country was probably Emeline Robert Jones of Connecticut. After Emeline Robert married Dr. Jones in 1854, she became very much interested in her husband's profession and wanted to assist him, but of course he would not have a woman in his office. Besides he considered dentistry no occupation for frail and clumsy fingers. It was only after she had demonstrated her skill and ability by filling several hundred extracted teeth that her husband consented to let her work on some of his patients. Mrs. Jones, however, was not satisfied to be merely a skillful mechanic. In her leisure time she studied anatomy and other scientific subjects related to the practice of dentistry. Ten years later, when her husband died and left her with two small children, she was able to carry on the practice quite successfully, supporting both herself and the children. Mrs. or Dr. Jones, as she was generally called, remained in active practice for nearly sixty years.

The honor of being the first woman graduate of a dental college anywhere in this country or in the world, belongs to Dr. Lucy B. Hobbs. She was also the first woman elected to membership in an organized dental

society. Like women pioneers in other professions she met with a great deal of opposition. Dentists, of course, resented the idea of a woman entering their profession. It was almost impossible for her to find anyone who would accept her in his office as an apprentice. It was unseemly to have a woman around and the professors of the Ohio Dental College, who were shocked at her boldness in seeking admittance to their institution, refused her application.

At last she found a dentist who agreed to give her instruction in spite of the risk of public and professional criticism. Soon Lucy Hobbs became a very competent operator, and opened her first office in Cincinnati without a diploma. This did not hamper her, for few male competitors were as yet school graduates. Several years later, she moved to Iowa and became known as "the woman who pulled teeth" and her reputation was that of a very skillful dentist. In 1865 she was elected to full membership in the Iowa State Dental Society. She then applied for admission to the Ohio Dental College and was accepted. When conferring the degree of "Doctor of Dental Surgery" upon her, Dean Taft said that "she was a woman of great energy and perseverance, studious in her habits, missing but one lecture during the session." It was her admission to the Dental College that disturbed the editor of the *Dental Times,* and prompted his statement that Providence has rendered the female of the species unfit to tinker with our molars. Dr. Hobbs' name appears on the list of members of the Woman's Advisory Council World's Columbian Dental Congress which was held in Chicago, in 1893. She died in 1910 at the age of 78, after practicing her profession for many years.

But Lucy Hobbs was an isolated case. The dental profession was not yet ready to admit women within its ranks. In 1867, Henrietta Hirschfeld of Berlin applied for admission in the Pennsylvania College of Dental Surgery, and the faculty would not accept her. The instructor in anatomy was particularly vociferous in his objections, but Mme. Hirschfeld persisted. After a great deal of effort she finally gained admission to the school but was obliged to go to the Women's Medical College for instruction in anatomy. It is recorded that the students hissed Mme. Hirschfeld upon her first appearance in the class room, but eventually they got used to having her in their midst, and treated her with consideration. This was due, probably, to her fine manners and good looks.

But the fight was not yet won. In 1868 Dr. James Truman the one member of the faculty of the Pennsylvania College of Dental Surgeons who

had supported Mme. Hirschfeld in her admission to the dental school, made an impassioned plea before the meeting of the dental association on a resolution to admit women into dental practice. The resolution was promptly tabled. Several years later, after a lengthy discussion, the Pennsylvania Dental School admitted three women. But at the end of the first year, a petition signed by a large number of students demanded that the women should not be allowed to continue their studies, whereupon the majority of the faculty, still not favorable to women in dentistry, assented to the request of the petitioners. Fortunately, Dr. Truman, who was a member of the faculty, objected to this decision and brought the matter before the board of trustees. This started an acrimonious battle, the echoes of which soon reached the general public. The local press joined in the fight against the reactionaries who opposed women students. The decision of the faculty was finally reversed and the three women were allowed to return and finish their course.

Toward the last decade of the nineteenth century, the objection to women in dentistry began to lose ground. There was a new spirit abroad. Female inferiority ceased to be self evident and opposition to women entering the different professions on mental or physical grounds went out of fashion. In 1880 there were 61 women dentists in the United States. Ten years later their number increased to 337 and by nineteen hundred nearly three times that number were in practice. At present 35 of the 38 dental schools accept women students on equal terms with men. Women dentists are now about two per cent of the total practicing in this country. This proportion has remained almost unchanged in the last twenty years.

Women are not entering dentistry in great numbers because they are not mechanically inclined. This alleged lack of mechanical skill was used by their early opponents as an argument for excluding them from the profession. There is no evidence, of course, that digital aptitude is the peculiar endowment of men, inherited through the male parent. However, conditioning in early life must have some influence. Girl babies are given dolls while boys are encouraged to play with trains and other mechanical toys. It is generally agreed that this difference in play habits during childhood has a determining factor in the inclination of the sexes toward manual occupations.

Another cogent reason for the reluctance of women to take up dentistry as a profession may be due to deeply ingrained social prejudices which have not yet disappeared entirely. Most men are reluctant to visit a woman

dentist; this attitude influences their wives and families. Unquestionably, the average woman dentist is at a disadvantage in competition with her male colleagues. The one field where women seem to have a better chance is in the care of children's teeth, because of the prevailing opinion that a woman is instinctively better fitted to handle children. This probably accounts for the reason so many specialize in children's dentistry.

EPILOGUE

It has been a long time since man climbed from the tree and began his arduous journey toward civilization. During his travels, his molars, which lasted his progenitors all their lives, have begun to rot and decay. His gums have softened and are frequently inflamed. Painful swellings have sometimes developed around his face. And we do not yet know the reason why.

Perhaps some day we shall find out, and, as often happened, we will then wonder why such a simple reason has eluded us for so many thousands of years. In the meantime, patients must keep on returning to the dentist, the modern Sisyphus, with more cavities, more decay, and more teeth that need to come out. And he, like the ancient toiler, will never catch up with his task!

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No. 1 killer of U.S. babies is whooping cough, which takes a heavier toll than scarlet fever, diphtheria, measles and infantile paralysis combined. Last week, doctors at the American Medical Association meeting in Atlantic City heard reports on 1) a new way to prevent the disease in newborn infants; 2) the serious mental effects of whooping cough.

Prenatal Vaccination. Newborn infants have a natural immunity to many infectious diseases, but they cannot be vaccinated against whooping cough before the age of seven months. Apparent reason: their bodies are incapable of producing the antibodies.

Drs. Philip Cohen and Samuel Jerome Scadron of Manhattan told how they solved this grave problem by vaccinating 200 mothers in the fifth or sixth month of pregnancy. About 150 billion whooping-cough germs were given to the mothers in injections at two-week intervals. The mothers developed antibodies in their blood streams, passed them on through the umbilical cord to their babies. The inoculations had no effect upon pregnancy or delivery.

Damaged Brains. In Cincinnati's Child Guidance Home, Drs. Louis Aryah Lurie and Sol Levy studied 58 children aged ten and eleven, who had come down with whooping cough in early infancy. Of these children, 34, or more than 58%, showed definite changes in behavior, personality and intelligence later in life—apparently, said the doctors, "as a direct result of this infection."

A "striking and characteristic finding" in these children was a delay in walking and talking; some of them had already started, but stopped after they had whooping cough. Others had convulsions, deafness, speech defects, subnormal intelligence. The incidence of mental deficiency, said the doctors, was much larger in this group of children than in the entire home.